THE MODEL ENGINEER

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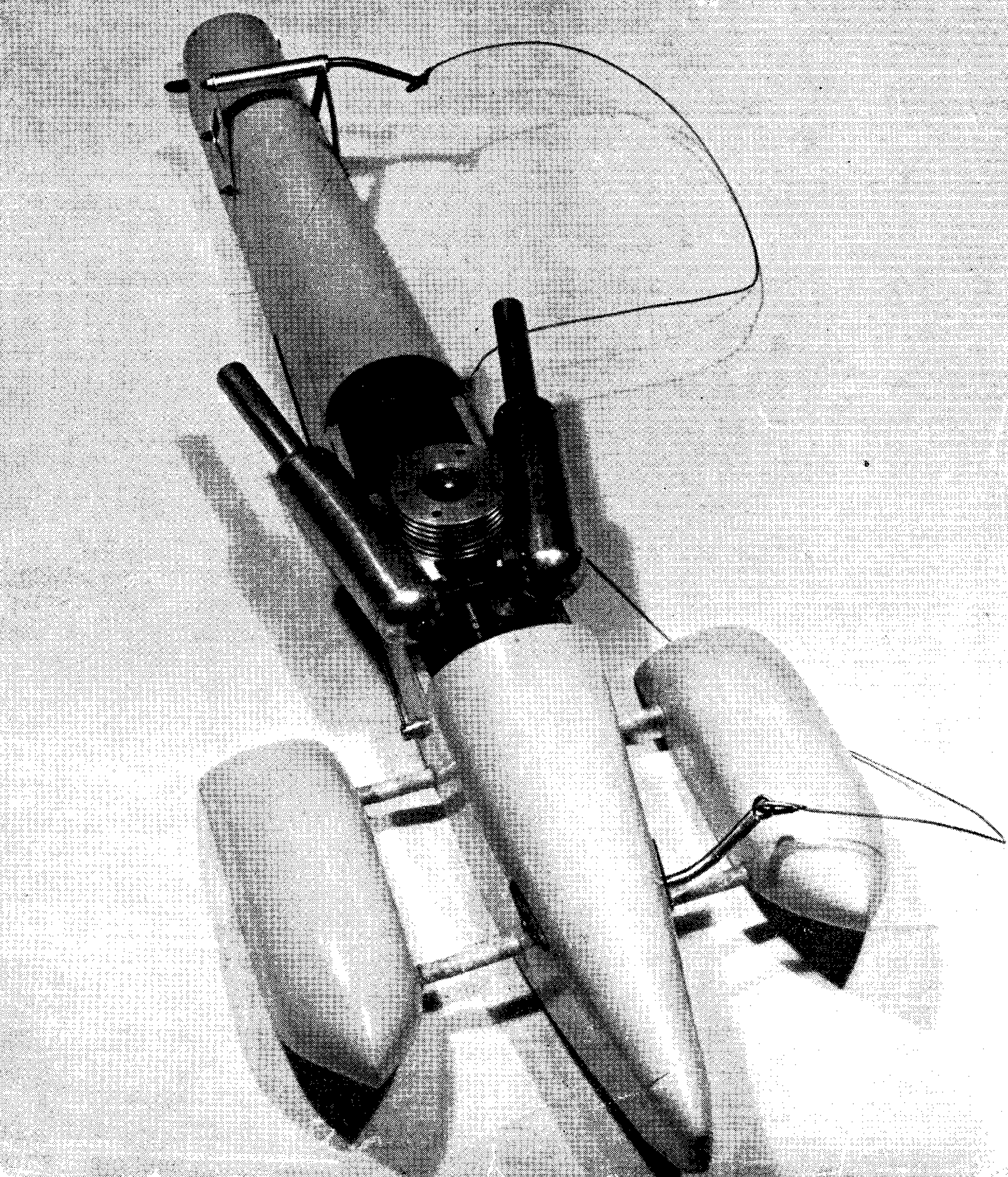


The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, *GREAT QUEEN ST., LONDON, W.C.2*

16TH FEBRUARY 1950 VOL. 102 NO. 2543

SMOKE RINGS

The Value of "Kit" Modelling

● PROBABLY ONE of the most criticised forms of model making today is that in which a kit of parts can be bought, leaving little more than the assembly of the parts to be done by the builder. Usually, the separate items in the kit have had all necessary machining or other process, completed to the point where the assembly requires the use of no workshop equipment, other than a hammer, or a screwdriver, a few files or, sometimes a soldering outfit. There are many of us who claim, not without reason, that this is not model engineering but a sort of pandering to a natural laziness which, perhaps, is latent in all of us!

But, surely, the kit form of model, which has acquired an enormous popularity in America and is rapidly finding favour in this country, has its uses. Much, however, depends upon the kit; some of them have been very carefully thought out so that their assembly, taken in progressive stages, arouses interest in the processes employed, suggests ideas for experimenting with similar processes but for a different kind of model and, therefore, tends to kindle a genuine practical interest in our hobby.

On the other hand, we have seen and—let us confess it—struggled with kits consisting of numerous pieces of metal cut and bent to their correct shapes, and merely requiring soldering together to make up into a satisfactory unit. Some of these would appear to have been inadequately planned by their producers; or, to put it another way, the kits seem to have been prepared upon the supposition that the assemblers are absolute experts in the use of soldering equipment. When such a kit comes into the hands of a raw novice, the result is quite likely to be disastrous, as far as kindling interest and pleasure in our hobby is concerned.

The ideal kit is obviously one which calls for the exercise of a little forethought, patience and ingenuity on the part of the assembler, embodies at least a slight modicum of real constructional practice, while, at the same time, ensures that the assembler cannot get into an inextricable and exasperating muddle. In cases like these, the chances are that the completed model is something which can be regarded with justifiable pride by its builder, whose interest has been sustained through every stage of the assembly and whose enthusiasm has been aroused to such an extent as to urge him on to attempt the construction of something more elaborate and original.

Things to Come

● IT IS rather a strange feeling that is aroused by the relaxation of the paper restrictions which have been so irksome to our readers and ourselves for so long! As soon as the news of the freeing of paper supplies was confirmed, we naturally began to think about future develop-

ments of THE MODEL ENGINEER. Certain alterations of a more or less minor character proved to be immediately possible, and already our readers are getting more material than ever before. But, nevertheless, starting from the March 2nd issue, we shall be adding eight pages each week, which will bring the standard total number of pages up to fifty two.

With the closing of our contemporary, *The Model Car News*, which, as readers will recall, was only published to relieve the pressure on space in THE MODEL ENGINEER during the days of acute paper rationing, we shall be publishing each week, constructive articles of interest to builders of model cars; further, on the third Thursday of each month, there will be some pages of current news and views of the model car hobby.

In this way, therefore, we shall be continuing to cater for the latest important developments in the model engineering field.

In addition to this, we intend to widen the scope of THE MODEL ENGINEER by covering at more frequent intervals a number of subjects which, hitherto, have been given space only rarely in our pages. Photographic and optical instruments, certain instances of usefully applied science in the home, may be cited as examples of the sort of thing we have in mind. Engineering prototypes, too, will be more frequently dealt with than has been possible for several years, and where descriptions of these are given they will be presented in a form that will be primarily of use to the model engineer and home craftsman.

Model engineering is a term that embraces rather a wider field than that covered by true *engineering;* it signifies a hobby, and that means something that should give a pleasant and healthy relaxation from the normal daily routine. To foster an interest in a hobby is one thing, to cater for it is another. Yet THE MODEL ENGINEER deliberately sets out to achieve both of these objectives and will continue to do so in the manner which has so materially contributed to the popularity of "Ours."

Beginning Again?

● CONSIDERABLE PLEASURE was aroused by the news that recently, Western Region engine No. 5098, *Clifford Castle,* in charge of driver Charles Kent and fireman Fred Sharman, set up a post-war record run with an Ocean Liner special train from Plymouth to Paddington. The train, details as to the loading of which are not yet available, left Plymouth at 8.55 a.m., and arrived in Paddington at 1.2 p.m., the 225¾ miles having been covered in 247 minutes, at an average speed of just over 54 m.p.h.

This run was accomplished, therefore, in exactly the original timing of the down Cornish Riviera Express; but the previous fastest post-war Ocean special from Plymouth to London had done the trip in 257 minutes, a time which *Clifford Castle* and her able crew have reduced by 10 minutes. Dare we hope that the next one will cut another 10 minutes from the time? If anything of the old G.W.R. spirit remains, we feel that our hope is justified.

It is a far cry from May, 1904, when, after some brilliant runs by Ocean Mails specials from Plymouth to London, the "record of records" was accomplished. In those days the route was the long one via Bristol, 247 miles. On May 9th, 1904, an Ocean Mails special, covered this distance in 226¾ minutes, including a stop of 3 minutes at Bristol, to change engines! That run has never been equalled; it was made by a 4-4-0, *City of Truro,* to Bristol, and a single-wheeler, *Duke of Connaught,* from there to Paddington. If such engines could put up a run like that, then, it ought to be possible for a "Castle" to equal it, if not beat it, forty-five years later. We shall watch future developments with interest, because we know what "Castles" *can* do when they are given the opportunity!

Obituary

● WE DEEPLY regret to learn that the model engineering hobby generally and ourselves in particular have lost another good friend, Mr. S. E. Stevens, who passed away suddenly at Folkestone on January 29th.

Mr. Stevens was not only an engineer by profession, and formerly well known in Reading, but he was an expert model maker, several times an exhibitor at THE MODEL ENGINEER Exhibition and a generous donor to the prize-list. His aim was to encourage good work in our hobby, and, himself, set the example. Not that he was a stickler for absolute perfection of detail reproduction, but he loved to see proper proportions, careful workmanship and good finish. He was never tired of discussing these features and offering friendly advice on them, and he was genuinely distressed when he saw a model which displayed evidence of having been skimped or rushed during its construction. He loved engines—stationary, marine and locomotive—for their own sake, and was always ready to discuss them with anybody. His well-equipped and scrupulously tidy workshop was available to anyone in difficulties, his kindly, warm-hearted nature being ever ready to help people less fortunate than himself. Yet, with all this, he never sought to impose his will or ideas on anybody; he much preferred to remain discreetly in the background and rather shrank from the light of publicity.

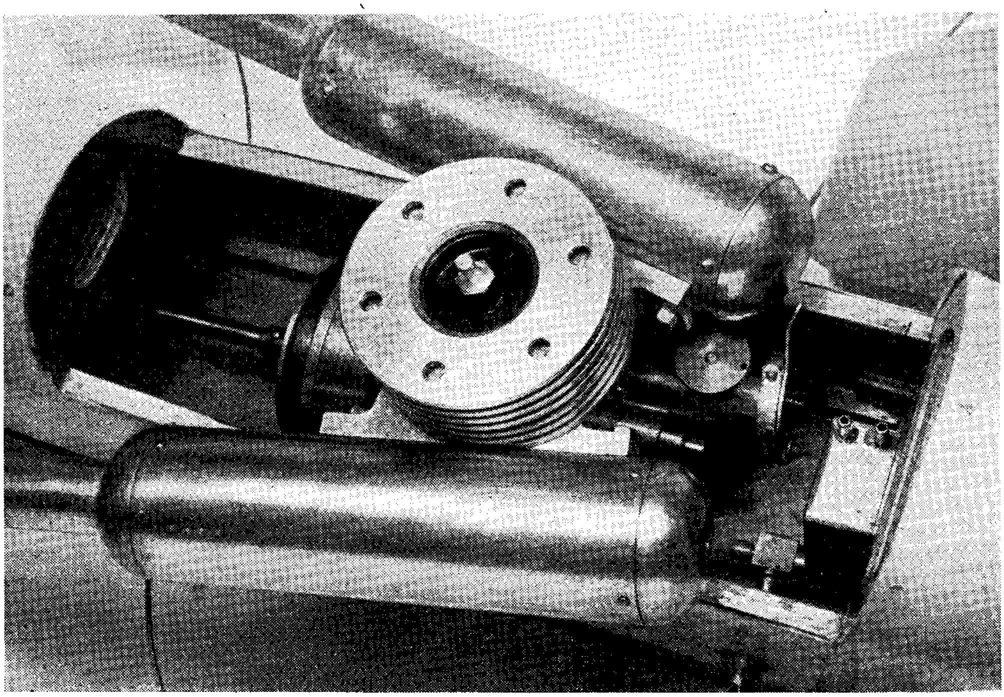
We have certainly lost a good friend whom we shall always remember with affection and respect.

We are also extremely sorry to learn of the death of Mr. Will Ryan, of Buck & Ryan Ltd., who died suddenly on January 26th from heart failure. He had been a staunch friend and supporter of THE MODEL ENGINEER for many years, was a personal friend of the late Mr. Percival Marshall and was known personally to hundreds of our readers.

Mr. Ryan was a very keen advocate of our hobby; wherever possible, he took stand space at model engineering exhibitions, especially in the London area, and he seldom, if ever, failed to be in attendance himself to give his personal attention to the needs of his many patrons. His cheery presence always did much to establish that mutual confidence between his customers and himself, and will be sadly missed by all who were privileged to know him. He was one of those who made a special point of studying his clients' needs and doing everything possible to meet them.

The MODEL ENGINEER 1949 Speed-Boat Competition

WE are glad to note that the entries in this competition are more numerous than in the past two or three years, and clearly show that model speed boats still rank among the most popular competitive branches of model activity, also that progress in design and achievement during the past season has been highly satisfactory. Many of the difficulties, restrictions, and interruptions, which originated in wartime, but influenced both the popularity and performance of these boats for long after, appear now to have been successfully overcome, and both design and construction of boats are advancing at a rapid pace. Increased speeds are in evidence in all classes, particularly the smaller and lighter boats, the performance of which is, in some cases, far beyond the most optimistic conceptions of a few years ago.



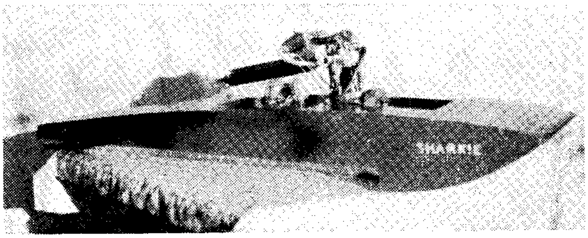
A close-up of the engine of Mr. G. Lines' "B" class boat, "Sparky II," from above. (This boat is also featured in this week's cover picture)

It is fairly certain that improvement in performance of engines is the most potent factor in the high speeds now being attained. Amateur constructors of these engines, who for many years had to feel their way in developing them from first principles, are now beginning to realise the extent to which efficiency can be obtained in respect of high rotational speeds and power output for a given capacity. In this, as in many other fields of engineering, progress has sometimes been retarded by old but very tenacious fallacies. Hard-and-fast doctrines have often deterred experimenters from trying out ideas which were considered fantastic at the time, but a few enterprising spirits have not been afraid to take chances, and many of these ideas have now proved successful.

A few years before the war, it was commonly believed that hydroplane hull design was approaching finality, but there are few experts who would be bold enough to say that at the present time. Some of the modern types of speedboat hulls embody features which, in their present form, have been imported from abroad, but their principles, at least, had been tentatively explored in this country many years ago. The same thing applies to the almost universal "surface" propeller, though the success of these hulls and propellers is dependent, to a great extent, on the availability of a considerable amount of engine power, far beyond the attainments of the early days. Some of the boats which were hopelessly unsuccessful in the days of the single tethering point, would probably

Name of Boat	Owner	Total Weight lb.	Engine				Hull			Propeller				Speed m.p.h.
			Cyls.	Type	Bore	Stroke	Length	Max. Beam	Steps	Dia.	Pitch	Blade area sq. in.	Blades	
			Class "A"—Steam											
Ifit VI	A. W. Cockman	$15\frac{1}{2}$	2	s.a.	$\frac{3}{4}$	$\frac{7}{8}$	38	$11\frac{1}{2}$	1	$3\frac{1}{4}$	$6\frac{1}{2}$	2.5	2	43.4
			Class "A"—Petrol											
Faro	K. G. Williams	$15\frac{3}{4}$	1	4-str.	$1\frac{5}{16}$	$1\frac{5}{16}$	40	12	1	3	6	1.84	2	56.8
Blue Streak ..	S. H. Clifford	$10\frac{3}{4}$	1	4-str.	$1\frac{1}{4}$	$1\frac{7}{16}$	34	9	1	$3\frac{1}{2}$	$6\frac{1}{2}$	—	2	55.6
Samuel	W. H. T. Meageen	10	1	2-str.	$1\frac{3}{16}$	1 3/32	32	10	1	$3\frac{1}{4}$	8	1.86	2	46.49
Rene VI ..	W. Tomkinson	$10\frac{1}{4}$	1	2-str.	$1\frac{3}{8}$	1.15	36	14	1	$3\frac{5}{8}$	9	2.25	2	38.6
Enid	R. Thomas	$15\frac{3}{4}$	1	4-str.	$1\frac{5}{16}$	$1\frac{5}{16}$	$35\frac{3}{4}$	12	1	3	$6\frac{1}{2}$	1.55	2	37.19
			Class "B"—Steam											
Vesta II ..	F. Jutton	$7\frac{11}{16}$	1	s.a.	$\frac{7}{8}$	$\frac{7}{8}$	28	$12\frac{1}{4}$	1	3	$7\frac{1}{2}$	1.8	2	51
			Class "B"—Petrol											
Sparky II ..	G. A. Lines	6	1	2-str.	$1\frac{1}{8}$	$\frac{7}{8}$	33	13	1	$3\frac{1}{2}$	8	2.1	2	58.75
Beta	R. E. Mitchell	$8\frac{1}{4}$	1	4-str.	1.07	1	32	$15\frac{1}{2}$	1	$3\frac{1}{4}$	5	1.8	2	45
Sparky I ..	G. A. Lines	$5\frac{1}{2}$	1	2-str.	$1\frac{1}{8}$	$\frac{7}{8}$	29	11	1	$2\frac{7}{8}$	6	1.75	2	42.94
Sharkie ..	H. V. Collins	$6\frac{3}{4}$	1	4-str.	1	$1\frac{1}{8}$	33	9	1	$2\frac{3}{4}$	5	1.5	2	40
			Class "C"—Petrol											
Jo Mac	D. Innes	$4\frac{1}{4}$	1	2-str.	15/16	$\frac{7}{8}$	30	9	1	$2\frac{3}{4}$	4.5	1.25	2	44.7
Moth	J. H. Benson	$3\frac{1}{8}$	1	2-str.	15/32	$\frac{7}{8}$	27	10	1	$2\frac{5}{8}$	6	1.125	2	38.2
Jinx	A. A. Sherwood	$\frac{7}{8}$	1	2-str.	0.6	0.6	15	$5\frac{1}{2}$	1	$1\frac{1}{2}$	5 app.	0.5 app.	2	29.1

have worked quite well with the modern two-point bridle. Despite the fact that knowledge of all factors in the design of model speed boats is improving year by year, there are, without a doubt, as many unsolved problems as ever, and little exact knowledge is available about the factors that affect the efficiency and stability of hydroplanes, the effect of altering planing areas or angles of incidence, or the precise action of a screw propeller, either completely or partially submerged in water.



Mr. H. V. Collins' "B" class boat, "Sharkie II"

Hull Design

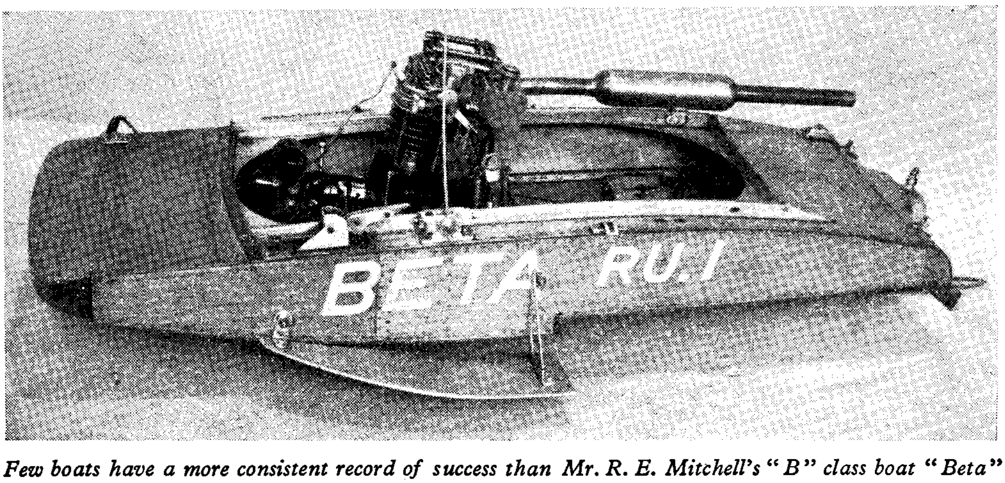
The "three-point suspension" type of hull is now predominant, and even hulls which were originally built to the older conventional lines of design, with integral stepped floor surfaces, have, in several cases, been converted by the attachment of separate planes, often of metal. In early trials of boats fitted with such planes, trouble was often experienced by the loosening or tearing away of the planes, and some good boats have met disaster, but it appears that modern designers have realised how great are the structural stresses on these attachments, and have learned how to fix them securely. All the hulls are of the single-step type in the accepted sense, that is to say, taking only the longitudinal aspect of the hull, and not counting any breaks in the transverse continuity of the hull floor. A "three-point" hull having two planing surfaces abreast at the front and one at the rear, is thus classified as a single-step hull; this applies whether the planes are integral or attached.

The beam of the hull is taken over the widest part, and in hulls which have planes projecting beyond the sides of the main structure, as many of them do nowadays, the ratio of beam to length is greater than in former years. The most pronounced tendency in this direction is shown in Mr. Mitchell's *Beta*, in which the beam is $15\frac{1}{2}$ in. in relation to the overall length of 32 in. Mr. Tomkinson's *Rene VI* has a ratio of 14 to 36, and Mr. Benson's *Moth*, 10 to 27. A fair amount of beam is essential to withstand the torque reaction of a large propeller, and is also conducive to producing a high aspect ratio of the main planing surfaces, but just to what extent this principle can be carried to real advantage is not yet determined.

Wood is still almost universally employed for hull construction, with the exception of minor metal parts, such as struts, facings and attached planes. Mr. Clifford's *Blue Streak* embodies a unique form of construction, in which the hull stresses are taken by a fabricated metal chassis, the main members of which are tubular, and are ingeniously utilised as fuel and oil tanks.

Propellers

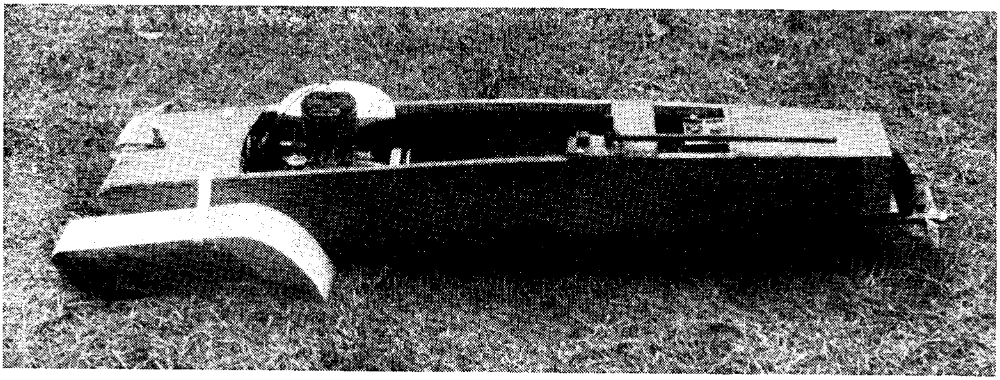
In most cases, these work only partially submerged, but this does not necessarily involve any changes in basic design, beyond some increase in propeller dimensions, and it is rather difficult to define the distinction between a "surface" and submerged propeller, if, indeed, any hard and fast boundary exists. So far as propulsion efficiency is concerned, there is little data on the relative merits of the two types, and it is possible that the improvement in performance obtained by surface propellers may be due more to the reduction of underwater resistance, by the elimination of an inclined shaft and projecting



Few boats have a more consistent record of success than Mr. R. E. Mitchell's "B" class boat "Beta"

stern bracket, than to any increased efficiency of the propeller itself. The partially submerged propeller is, however, less liable to stall in getting the boat away, and it also enables a coarser pitch to be used for a given available engine torque.

It will be seen that the two-bladed propeller is still universally employed, and a possible reason for this is that it is the simplest form of propeller to construct and adjust, but there is reason to believe that increasing the number of blades would be more likely to lower efficiency than to raise it, owing to possible blade interference at high speed. The idea of using a single-bladed propeller has often been discussed, and some experiments have been made in this direction during the past season, but without any signal success so far as is known.



A worthy successor to "Satellite III"—Mr. D. Innes' new "C" class boat

Engines

Two examples of flash steam boats, both of them so well-known to our readers as to call for little comment, are included in the entries. It is rather a pity that this form of motive power appears to be declining in popularity at the present time, especially in view of the part which it played in the early development of the model hydroplane. Most of the many devotees of steam, however, unlike those of i.c. engines, appear to be content with the more conventional applications of this medium, and do not seem to be interested in exploiting its possibilities for higher efficiency.

The two-stroke engine is definitely predominant in the smaller classes of boats, accounting for all the entries in "C" class, and it is also more in evidence in the larger classes than it was a few years ago. It is worthy of notice that all the two-stroke engines featured in this competition, while embodying visible features which have been much exploited by commercial producers in recent years, also incorporate features and principles which were described and advocated in THE MODEL ENGINEER many years before commercial engines were produced. The suggestion frequently made that constructors of these engines simply copy the commercial product may be true in certain individual cases, but generally speaking, it may be said that the boot is definitely on the other foot. A particular feature of design which is now considered practically essential to high efficiency two-strokes, namely the disc rotary admission valve, was incorporated in designs for speed boat engines published in THE MODEL ENGINEER over twenty years ago.

The engines of both Mr. Meageen's and Mr. Tomkinson's boat have all-round exhaust porting, with transfer ports below the exhaust. It is worthy of note that the former engine has much smaller bore and stroke dimensions than are called for by class restrictions, being only about 20 c.c. A still more striking example of what a small engine can do is afforded by that of Mr. Sherwood's *Jinx*, which is only of 2½ c.c., but makes quite a good show against engines of nearly four times the capacity. In the larger classes of boats, the four-stroke engine, which was always favourite in the past, still appears to hold its own in spite of the phenomenal advance of the two-stroke. It is well that the development of the four-stroke should continue, if only to provide the variety which enlivens interest in engine design. There is still room for profitable research into the finer points of design in these engines, and although they are more complicated in construction, they are no more difficult to build successfully, and probably easier to tune than the two-stroke, while one of their incidental advantages is that they are much less aggressively noisy than the latter.

The engines of *Faro*, *Blue Streak* and *Beta* have been fully described in the "M.E." and therefore call for little comment. *Enid's* engine follows the same design as that of *Faro*. The 15-c.c. engine of *Sharkie* appears to follow the design of the well-known "Kittiwake" engine described some years ago in the "M.E." In all cases, these engines have inclined overhead valves, operated by push rods, and in other respects follow well-established principles of design. All petrol engines in this competition are of the single-cylinder type, and nearly all are short-stroke or "square" engines, the one exception to this rule being that of *Blue Streak*. It is rather interesting to note that float feed carburettors are fitted to all the four-stroke

engines in the competition, and direct-feed suction or gravity carburettors to all the two-stroke engines. Another distinction is that glow-plug ignition is used on the two-strokes and spark-ignition on the four-strokes. Miniature magnetos are used on the engines of *Beta* and *Sharkie*.

Personalities

Both old hands and newcomers figure with equal success in this competition, the latter bringing in an infusion of new ideas, which is a welcome change from the tendency to stagnation which has sometimes been indicated in the past. This does not suggest, however, that the veterans are lacking in originality, or slaves to convention. All the results shown here have called for considerable spade work and perseverance. None of them have been obtained by a mere stroke of luck, or the result of a flash of genius. For length of experience, Mr. Clifford, of the Victoria M.S.C. takes first place, having been a pioneer with flash steam boats in the early 'twenties, and for many years his spectacular record of 43 m.p.h. with *Chatterbox III* was held against all challengers. His colleague, Mr. Cockman, is noted for his devotion to flash steam through many years of patient experiment, which often failed by a hair's breadth to win the award it deserved.

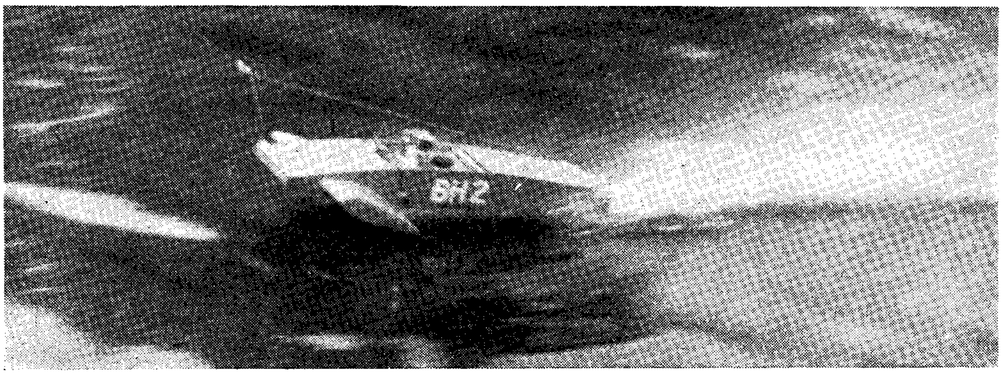
The career of Ifit *VI* culminated in another crash this year, and the speed shown in this competition is definitely not the maximum of which the boat is known to be capable. The construction of a new hull is now in progress. Other pre-war exponents who are also well known to readers are Messrs. Williams, of Bournville, Innes, Tomkinson and Meageen, of Altrincham, and Thomas, of West Midlands.

Mr. Jutton, of Guildford, is another adherent to the cause of flash steam, and if a prize were awarded for regular attendance at regattas, he would surely qualify for it without comment. Mr. Lines, of Orpington, whose flash steam experiences were, on the whole, somewhat disappointing, in spite of persistent and intelligent efforts, has now turned to i.c. engines, and produced rapid and spectacular success with two boats built during the course of the season, the second of which has now just started to show its possibilities. Mr. Benson (Blackheath), in spite of his diligent labours in administering the affairs of the rapidly expanding M.P.B.A., still finds time to build boats, and in addition to cruising steamers, has built several hydroplanes, mostly propelled by flash steam. The present example represents one of his first attempts at i.c. engines. Mr. Sherwood (Victoria) has long been known as a past master of ultra-miniature engines and power boats, but has recently turned his attention to racing with a size of engine which, from his point of view, appears colossal.

The fortunes of Mr. Mitchell, of Runcorn, have not been in the ascendant during the past season, in spite of good work having been put in on hull and engine improvements. *Beta* is noted for clean and apparently effortless running, not to mention a degree of silence which is almost uncanny in a really fast boat. Little is known of the personal history of Mr. H. V. Collins, of Victoria, but from the workmanship he has put into *Sharkie* and the results obtained in a comparatively short racing career, it is evident that he is a worthy initiate to the model speed boat fraternity.

Most model engineers have who tackled the construction of model speed boats will agree that they are among the most difficult types of models to produce successfully, and the acid test of high performance to which they are subjected is applied to no other form of model. There is a constant demand among readers of THE MODEL ENGINEER for more and more information on the subject of model speed boat design, and this constitutes definite proof of the amount of interest in this subject, so that no excuse should be necessary for mentioning the constructors, as well as their work, at least once a year in the report of the "M.E." Speed Boat Competition.

All entrants in this competition have qualified for certificates in their respective classes, and silver and bronze medals will be awarded for first and second places in each class. Each of the steam-driven boats (in "A" and "B" class respectively) qualify for a separate silver medal.



An impression of Mr. J. Benson's "C" class boat "Moth" at full speed

An Aneroid Barometer

Converted from an Ex-R.A.F. Altimeter

by J. D. Hibbert

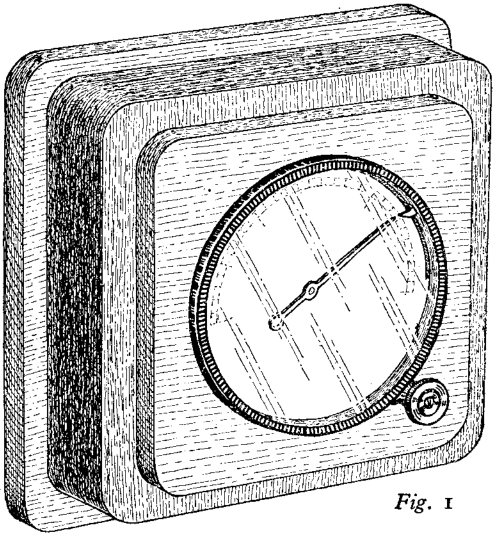


Fig. 1

AN *Ex*-R.A.F. altimeter can be bought for a few shillings and this precision-made instrument needs only a few simple modifications to make it into a really reliable barometer, which, when fitted in a wooden case, looks quite neat.

The main difference between an aneroid barometer and an altimeter is in the length and values of the scales. The table, Fig. 2, shows the relative atmospheric pressures at the lower altitudes. With a barometer the scale usually covers pressure differences of 3 in. or 4 in. of mercury, while the altimeter, reading to 30,000 ft. or more, covers a pressure difference of over 20 in. of mercury. It will be seen that to convert an altimeter into a barometer the mechanism requires modifying so that, for the limited pressure difference required, the movement of the pointer is greatly increased.

To do this it is first necessary to consider how a barometer works. The main part is an evacuated capsule from which as much air as possible has been extracted. As the atmospheric pressure operates on the outside of the capsule, it tends to flatten it, so that the greater the pressure the greater the deflection caused. This deflection is actually quite small but by means of a system of levers the movement is magnified and made to rotate the pointer round the scale.

From the diagram, Fig. 3, it will be seen that the connecting link transfers the movement of the capsule to the adjustable lever. This swings the quadrant which turns the small pinion attached to the shaft carrying the pointer. A small hair spring (omitted from the diagram) minimises the error due to slight slackness in the mechanism.

If the effective arm of the adjustable lever is decreased to about a quarter of its original length, the pointer should turn through four times the angle for a given movement of the capsule.

Details of the modification to the adjustable lever are given in Fig. 4. After taking out the adjusting-screw and filing off the riveted part, the forked end is removed from the adjusting-screw. The small hole can be opened out with an ordinary hand brace but care must be taken to see that the drill accurately follows the original hole without breaking through the side of the adjusting-screw. Replace the forked end in the adjusting-screw, cut off the surplus metal and lightly rivet over the end. The adjustable lever is then screwed into the pivot in the opposite direction from that in which it was originally found. This will cause the pointer to rotate in the reverse direction, as is usual for a barometer.

The next modification to the mechanism is to move the quadrant on its shaft so that the pinion in its normal working position works at the centre of the quadrant. With a hot soldering-iron, melt

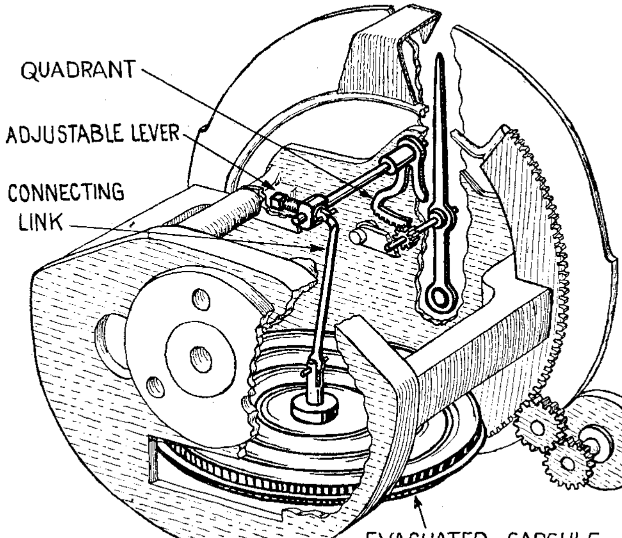


Fig. 3

the solder which holds the quadrant to the boss and reset it at the desired position. To suit the new conditions the connecting link will require shortening. This can be done by cutting it and soldering the two parts so that the holes at either end are the correct distance apart.

BAROMETRIC PRESSURE. INCHES OF MERCURY.	ALTITUDE. IN FEET ABOVE SEA LEVEL.
29·92.	0
28·86.	1,000
27·82.	2,000
26·81.	3,000
25·84.	4,000
24·89.	5,000

Fig. 2

A new face can be made from polished aluminium or plastic material. This should be made the same size as the original face, but the radius of the top part should be reduced by about $\frac{1}{16}$ in. to allow the adjustable pointer to pass through from behind the face. The material should be marked off and carefully filed to fit tightly in the plastic case. The scales should be roughly marked in pencil but the finished calibration should be left until later.

On an altimeter, provision is made for varying the zero reading to allow for difference of barometric pressures. This adjusting knob, pinion and semi-circular rack are used to operate the adjustable pointer. From a piece of thin brass cut the pointer to the shape shown in Fig. 6. A piece of wire should then be bent to the same profile as the inner radius of the semi-circular rack and soldered to the rack to complete the circle. The pointer should be soldered to the

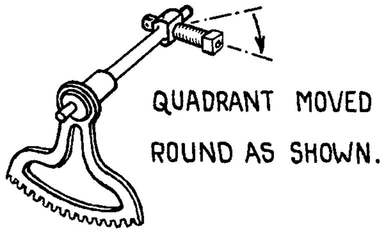


Fig. 5

wire in the top position when the joint between the rack and the wire is at 45 deg. This ring now fits where it did originally, but instead of being screwed to the frame it is allowed to slide in two brass guides secured to the frame. As it is difficult to solder the alloy framework, the guides can be bound with thin wire secured with a touch of solder.

To improve the appearance of the indicating pointer it is necessary to scrape off the luminous substance and file it to a narrow point. The pointer should then be rebalanced by cutting away the lead counter-balance.

As the pipe connection to the altimeter will not be required, it can be sawn off flush with the brass flange. To complete the modification to the instrument, the frame should be secured to the brass flange so as to prevent the whole turning. This can be done by drilling a small hole through both parts and driving a tight-fitting pin through it.

The various parts should then be thoroughly cleaned and reassembled in the plastic container.

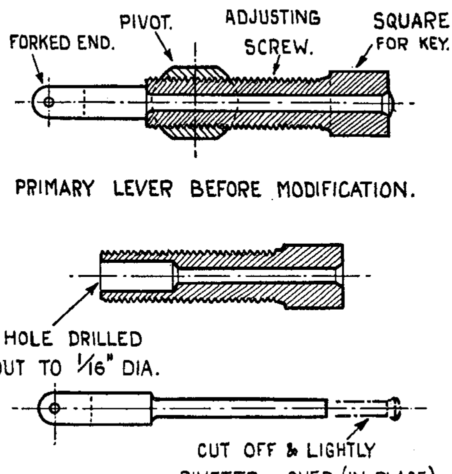


Fig. 4

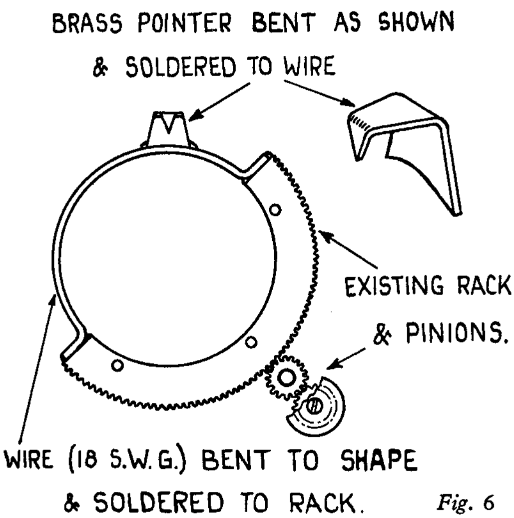


Fig. 6

The instrument is now a barometer and the rough calibration can be checked against any other barometer which gives accurate readings. When the other barometer records a pressure difference of at least 1 in. of mercury the distance the pointer has moved on the new scale can be marked. The scale can then be extended in each direction, as shown in Fig. 7.

The drawing of the case, Fig. 8, gives all the necessary dimensions for cutting out the pieces of wood. Any suitable wood may be used but by making the centre section of red mahogany and the front and back sections of white mahogany (or African white wood), full advantage can be taken of the difference in colours. Small pieces of these woods can be obtained from cabinet makers' cut-offs. The $3\frac{5}{8}$ in. diameter hole in each section can, if a lathe is not available, be sawn out with a scroll saw. The holes in the centre and back sections do not show in the finished article but the front section requires a good finish, because it is clearly visible.

The instrument should be screwed into the centre section and the front section secured to it by screws put in from the back, being careful that the screws do not break through the front surface. Then the back section is screwed to the centre section. After assembling, the case should be taken apart for polishing. To bring up the grain the parts should be rubbed with clear boiled linseed oil; when this is dry, any roughness can be removed with old smooth sandpaper. Two coats of french polish should be applied and lightly sandpapered down. The case should be assembled and given a final coat of french polish.

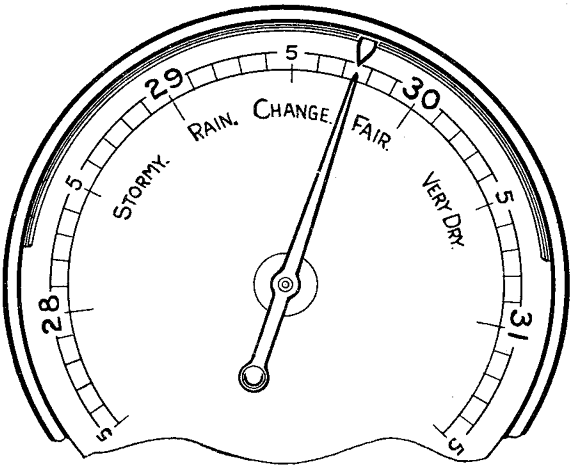


Fig. 7

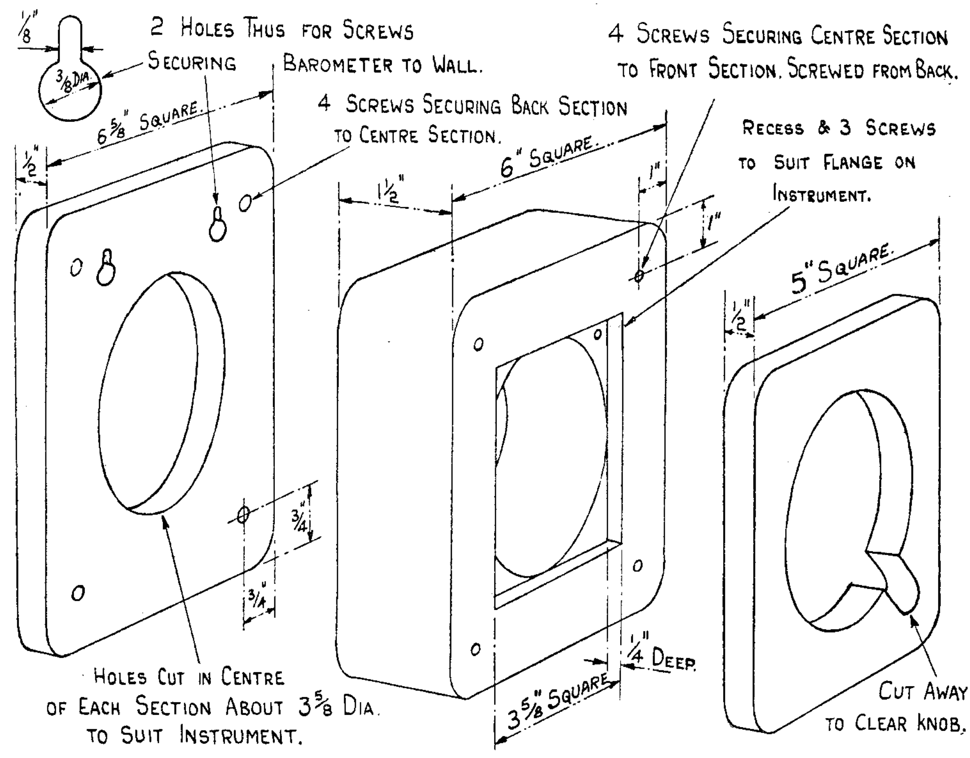


Fig. 8

Division Plates Without Tears

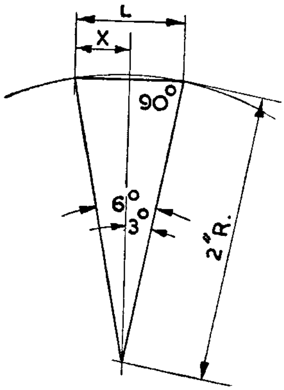
by A.E.V.

MOST of us require at some time or other an accurate division plate, but the methods open to us for the production of this require a fair amount of skill and do not guarantee results.

For example, it is perfectly easy to " box off " the holes after calculating their positions by " trig," but it is another matter to drill them accurately to limits of less than .00025.

It is also easy to set up a change wheel as a division plate, but unless it is new and accurately cut the results cannot be guaranteed.

A simple but tedious method is as follows :— First, it is necessary to decide the number of holes required and the pitch-circle diameter, and then calculate the chordal pitch of the hole centres.



For the purpose of this article, say 60 holes on a 4-in. P.C.D. Next, divide 360 deg. by 60 ; this gives the angle of the segment between any two holes. From this can be calculated the chordal pitch.

Formula for Establishing the Chordal Pitch

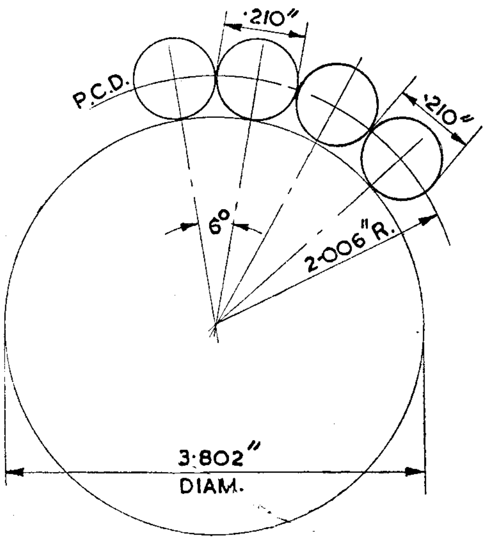
(*See diagram above*)

L = Chordal pitch.
To find L, one must first find x.
$x = Sin.\ 3$ deg. $\times 2$
$Sin.\ 3$ deg. $= 0.05234$
Therefore, $x = 0.05234 \times 2 = 0.10468$
Wherefore, $L = 0.10468 \times 2 = 0.20936$
The chordal pitch is therefore 0.20936.

As 0.20936 is an awkward dimension, it can be called 0.210 and our pitch circle becomes 4.012.

Sixty drill bushes are now needed, 3/32 in. bore, 0.210 o.d. × ½ in. long, one bung to fit the bore of the division plate having a head 3.802 in. dia. × ¼ in. thick and some plaster or " Cerro Matrix."

The next stage is to mark out the pitch circle on the division plate and divide it into 60 parts, then drill and tap 10 B.A. at every division. Insert the bung and place a drill bush over a 10 B.A. hole, screw it down, ensuring that the bush is in contact with the bung, and follow on round the bung with the rest of the bushes. It is extremely important that all the bushes touch each other at the bung. The bushes must now be encased in plaster or " Cerro Matrix." If " Cerro Matrix " is used, the job must be warmed up so as to remove all traces of moisture ; failure to do so can result in a serious accident. The advantage of " Cerro Matrix," however, is that it does not shrink on cooling and will hold the bushes as effectively as a jig-bored drill plate.



Layout of set-up (not to scale)

When whatever the bushes are set in has hardened, the screws should be removed and a 3/32-in. drill (very sharp) run through so as to open up the 10 B.A. holes. *Note* : After the first hole has been opened up, a 3/32-in. dowel should be inserted so as to stop the improvised drill-jig from " creeping."

Remove the improvised—but accurate—jig from the division plate and chamfer the edges of the 3/32-in. holes with a centre drill. You now possess an accurate division plate.

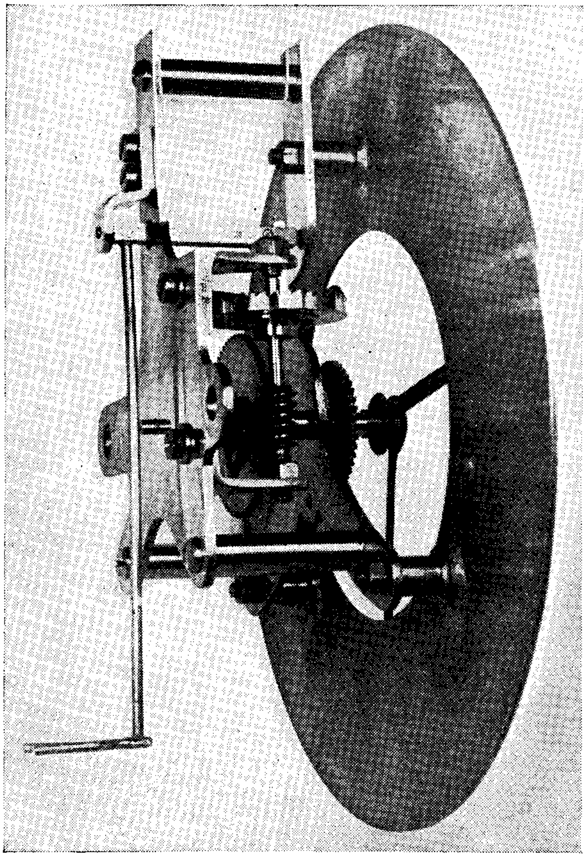
The point to remember is that, although tedious, this method is accurate and the only thing to equal it would be a jig borer.

*A Battery-Driven Electric Clock

by C. R. Jones

ANOTHER bracket, the rear bearing for crutch spindle, (material as before) was made to dimensions shown on the drawing, and a 3/32-in. hole drilled slightly smaller and finally broached later.

The backstop was made from a piece of 5/32-in. square silver-steel, and the first operation was to drill a No. 5-B.A. tapping hole dead in the centre of one side. This was then tapped with a partial thread, using a taper tap only, and a No. 5-B.A. brass screw was screwed in tightly, and cut off flush on either side. This brass bush was centred and drilled with a $\frac{1}{16}$ in. diameter hole, and formed a bearing for backstop. The remainder of the backstop was then cut and filed out of the solid, the blade portion being finished to about 1/32 in. thick. The end was hardened when finished, and polished with a fine oilstone.



Side view of wheelwork

Spindle for Count Wheel

The spindle for the count wheel was made from $\frac{1}{8}$ in. diameter silver-steel, care being taken that a straight piece was chosen.

A pivot was turned on each end, and polished to a diameter of $\frac{1}{16}$ in., the lengths being given on the drawing.

The count wheel was turned up from a piece of phosphor bronze to the dimensions shown, forty saw-shaped teeth being cut, as shown, using a change-wheel for dividing, and the small cutter frame and a fly-cutter described in a previous article in the issue of April 1st, 1948.

The centre hole was drilled with a No. 31 drill, and was opened out with a type of D-bit made from a piece of $\frac{1}{8}$-in. diameter silver-steel, cut off at an angle of about 45 deg., hardened and carefully stoned up. This was tried out on a trial piece of bronze, and stoned down slightly to ensure that it made a hole which would drive tightly on a piece of $\frac{1}{8}$-in. silver-steel.

Centre Wheel (F)

The centre wheel was made from a similar piece of brass to the plates, and had a $\frac{1}{4}$ in. reamed hole through its centre. This blank was mounted on a stub of brass about $1\frac{3}{8}$ in. in diameter, and which had a small spigot turned a good fit in centre hole in blank, the spigot being drilled and tapped No. 2 B.A. and the wheel blank secured with a suitable screw and stout washer. The outside of blank was turned down to 1 19/32 in. in diameter, and sixty teeth to a 55 deg. angle were cut in its periphery using the same equipment as before.

A brass boss (*G*) was then turned up to the sizes shown on the drawing, and one side of the $\frac{1}{4}$ in. diameter hole in the wheel was countersunk and the boss riveted into position.

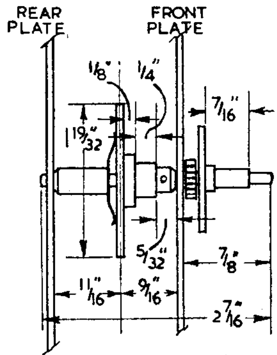
The material used for the worm was silver-steel, and it was threaded 12 t.p.i. with a 55 deg. angle, the diameter being $\frac{5}{16}$ in., and the hole through

*Continued from page 173, "M.E.," February 9, 1950.

the centre being drilled with a No. 31 drill, using the D-bit as before.

While the worm was still in the lathe, the centre wheel was mounted on a $\frac{1}{8}$ in. diameter pin fixed vertically in a piece of flat material held in the toolpost, and the worm and centre wheel run together with "Globe" metal polish and oil.

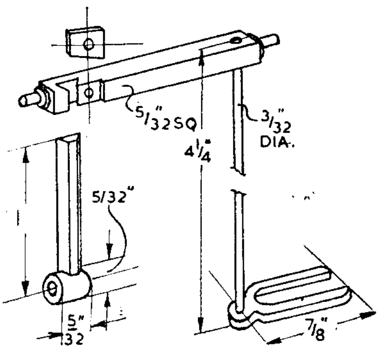
After running in, the worm was parted off, and both it and the wheel were washed in petrol.



CENTRE WHEEL & SPINDLE

The Spindle for Centre Wheel

This was a piece of $\frac{1}{8}$ in. diameter silver-steel, with a small collar (*H*) driven on to the correct position, and then sweated on using the small hole shown to feed the solder through.



CRUTCH SPINDLE & ADJUSTABLE LEVER FOR OPERATING PAWL.

Friction Spring (E)

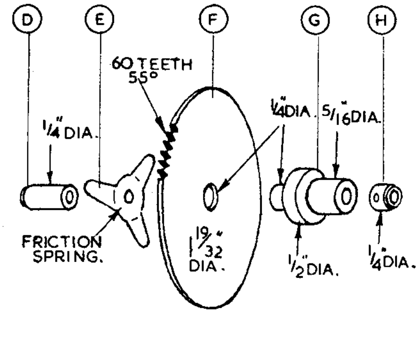
Having made sure that the centre wheel, now mounted on its boss revolved freely on the spindle, some sort of clutch had to be incorporated to enable the hands of the clock to be set, and a three-armed friction spring was discovered in the scrap-box and brought into service.

To retain this in position, a sleeve (*D*) was made from $\frac{1}{4}$ in. diameter steel, of a length to make up the whole assembly to just under $1\frac{1}{4}$ in. in length, so that it would work freely between the plates.

Of course, this entirely depended on how much the friction spring had to be compressed to give just the right tension for the operation of the hands, but still allowing them to be reset. As this depends to a great extent on how strong the spring is that is used, no length of this sleeve can be given.

Count Wheel Assembly

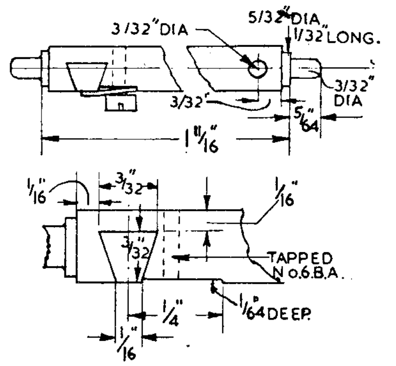
The count wheel and the worm were now driven on their spindle in the correct positions, and two No. 2-B.A. brass studs $\frac{3}{8}$ in. long turned up and threaded in the lathe. These were drilled



EXPLODED VIEW OF CENTRE WHEEL.

at one end $\frac{1}{16}$ in. in diameter for a depth of $\frac{1}{8}$ in., the other ends being slotted for a screwdriver.

These studs go in the No. 2 B.A. threaded holes in the bracket for count wheel spindle, and act as bearings.



DETAILS.

The count wheel spindle assembly was now placed in position, and the top stud was fitted in place with its locknut on top of the bracket. The lower stud was fitted with the locknut inside bracket, as can be seen in the photograph.

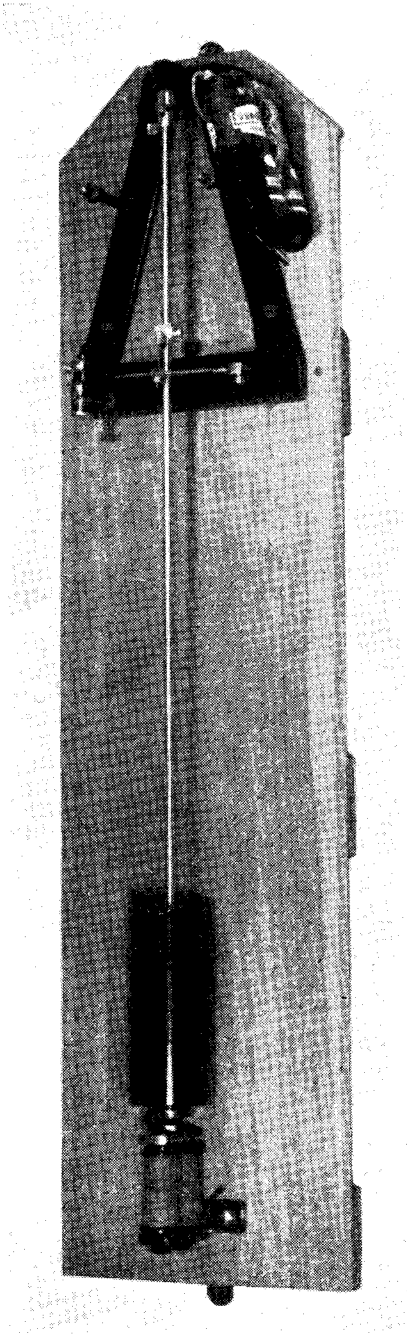
These studs and nuts were adjusted to give minimum play with easy running of count wheel and spindle.

The backstop pawl was placed in position, and a $\frac{1}{16}$ in. diameter hardened pin inserted a tight fit in the holes of the bracket, making sure that the pawl itself worked freely.

Crutch Spindle and Adjustable Lever

The crutch spindle was made from a length of 5/32-in. square silver-steel, which was set up in the four-jaw chuck, at each end of which pivots

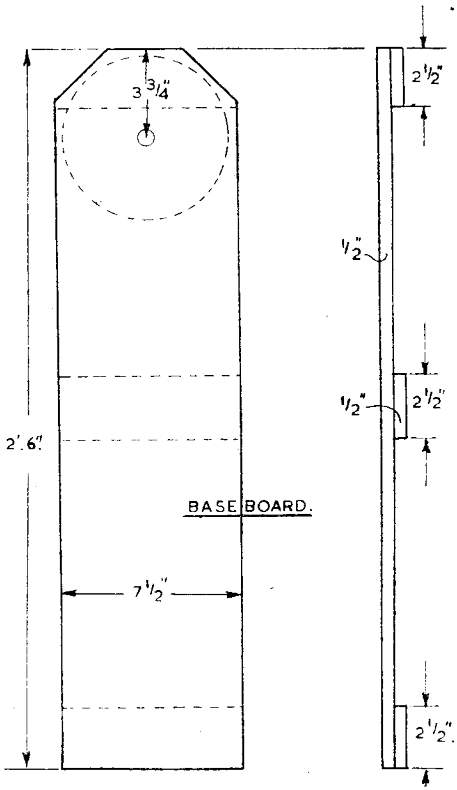
were turned 3/32 in. in diameter by 5/64 in. long, and a shoulder was turned also 5/32 in. in diameter by 1/32 in. long, the length of spindle in between the pivots being $1\frac{11}{16}$ in.



With dial and wheelwork removed

At the forward end a dovetail slot was cut and filed out 3/32 in. deep, 3/32 in. wide at the base and $\frac{1}{16}$ in. at the open end.

A slight recess was also filed in as shown 1/64 in. deep by $\frac{1}{4}$ in. from the centre of the dovetail recess, all dimensions being given on the detail drawing. A hole was also drilled where shown and tapped No. 6 B.A.



The adjustable lever was also made from 5/32 in. square silver-steel, and was first drilled and bushed, and redrilled $\frac{1}{16}$ in. diameter, in the same manner as described for the backstop.

It was filed up to the sizes shown on the drawing, the stem part being filed to dovetail section to be a good sliding fit in the dovetail slot in spindle.

This lever was held in place by a small plate made from a piece of hacksaw blade, which rested at one end in the 1/64 in. recess, and pressed at the other end on the narrow part of the stem of lever, thus allowing the lever to be adjusted for length.

A 3/32-in. hole drilled 3/32 in. from the other end of spindle had a $4\frac{1}{4}$ in. length of 3/32 in. diameter silver-steel pressed in, and carries the crutch at the lower end, which was made from brass $\frac{1}{16}$ in. thick, the slotted portion being made a comfortable fit on pendulum rod. This was made a good fit on the length of silver-steel, and soldered into position.

(To be continued)

Stainless Steels and the Model Engineer

by F. E. Knapp

THERE is no doubt that stainless iron and steel offer attractive possibilities in making most models or small power units. That shaft or connecting-rod, after being turned or milled, and afterwards highly polished, will not be affected by our old enemy—rust, and this is an advantage for those unpainted parts in inaccessible positions, or stored in the garden shed.

Moreover, stainless steels possess, in varying degrees, a higher tensile strength than mild-steel. This again is quite useful from the point of view that parts may be made nearer to scale without being too weak.

It must not be assumed that these materials are immune from the corrosive attacks of all and sundry liquids.

For instance, special grades only are acid-resisting and all grades are not unaffected by sea spray. However, the more work put into the polishing operation, the greater will be the resistance to corrosion.

chromium and 12 per cent. nickel are excluded from this discussion, although stainless.

A property associated with steels in the austenitic group is known as "work hardening." A dull cutting tool in the lathe, or a dull hacksaw blade will cause the surface to harden where the tool is attempting to cut. Hammer blows or centre-punch marks will cause local hardening.

Cutting speeds of 40-60 ft. per minute are usually the best, with a tool having a top rake of 15 degrees. Finishing cuts are best made at a cutting speed somewhat higher, bearing in mind the necessity of keeping a keen cutting edge.

In the writer's experience, soft soldering is readily performed on all stainless steels, giving a strong joint, and in these cases spirit flux must be used.

Silver-soldering is possible, but with this method it is rather difficult to obtain a satisfactory joint.

Welding processes of all kinds—electric arc,

Machinability	General Classification	Uses	Average Composition
Good	Ferritic (Stainless Iron)	Parts not to be hardened by heat treatment	Less than 0.15 per cent. carbon, 18 per cent. chromium, remainder iron
Good to Fair	Martensitic	Cutlery and similar hardened parts by heat treatment	0.15 per cent. to 0.4 per cent. carbon, 14 per cent. to 18 per cent. chromium, 0 to 2 per cent. nickel, remainder iron
Difficult	Austenitic	Not hardenable by heat treatment, but work hardens. Has greatest resistance to corrosion	Less than 0.15 per cent. carbon, 18 per cent. chromium, 8 per cent. nickel, titanium, remainder iron

Disadvantages from the modeller's point of view are :—

(*a*) Difficulty in obtaining small quantities of material of the most suitable grade with which is associated:

(*b*) Machinability,

(*c*) Cost.

In order to give a clear picture of the various categories of stainless steels in common use, the table above is offered as an elementary comparison.

Heat resisting steels containing 25 per cent.

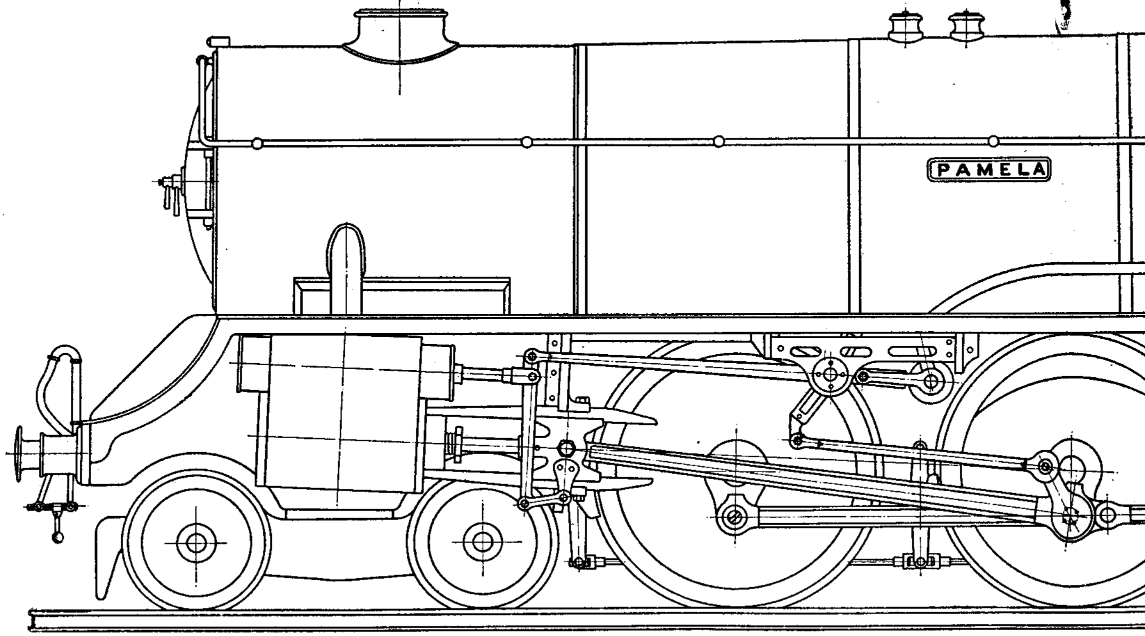
resistance, and oxy-acetylene, are very widely used on most grades of stainless steels industrially. Special precautions are necessary where the austenitic group are subject to severe corrosive conditions. This is, however, somewhat outside the scope of the model maker.

In the writer's view greater use could be made of stainless sections for model work, always provided that easily machinable grades are selected and are available through model supply concerns. Exceptional resistance to corrosion is not required for the purposes of model engineers.

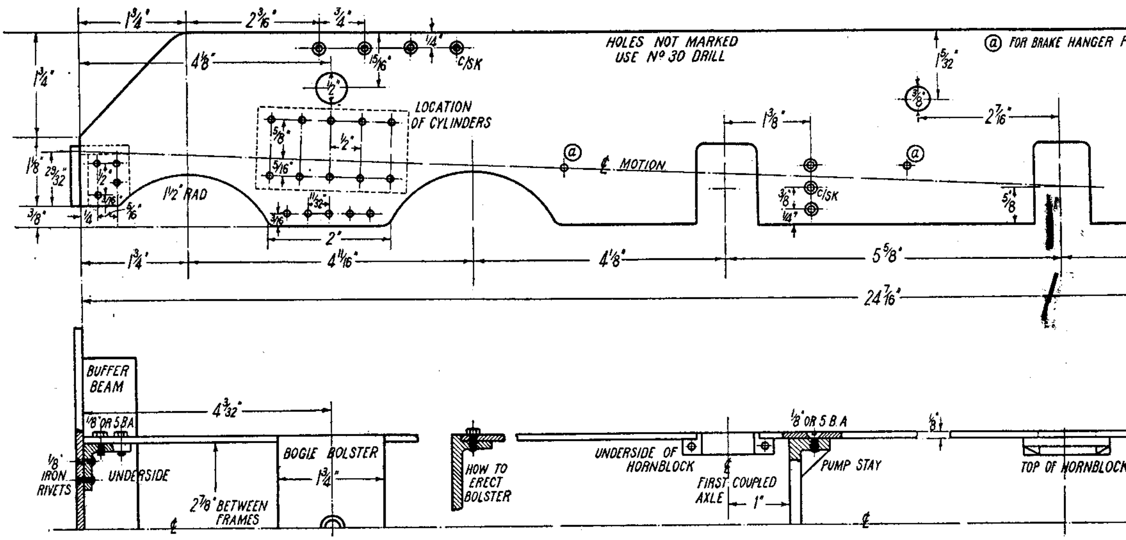
"PAMELA"

A $3\frac{1}{2}$-in. Gauge Rebuild of a

PRACTICALLY all followers of these notes who live in the Metropolitan area, read an evening newspaper ; and doubtless many of them have read, and sympathised with, the numerous correspondents who have written to the newspapers complaining of the bad timekeeping, and other defalcations, of the main-line steam services on the Southern Region, particularly the Eastern section. Nettled by the repeated assertions that the much-vaunted streamlined Pacific engines were apparently unable to do the job, one of the drivers of the " spam cans " promptly retaliated with a letter saying that if the complain-



" *Sweet beauty unadorned*"—(



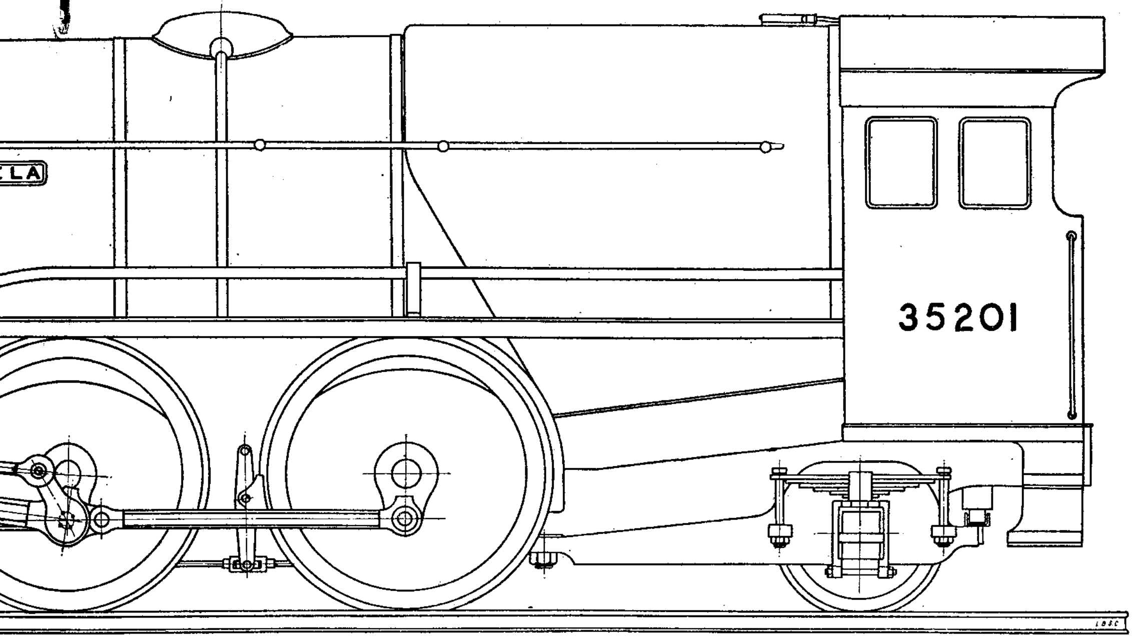
Main frames and cradle, and, below, half pla

” by “ L.B.S.C.”

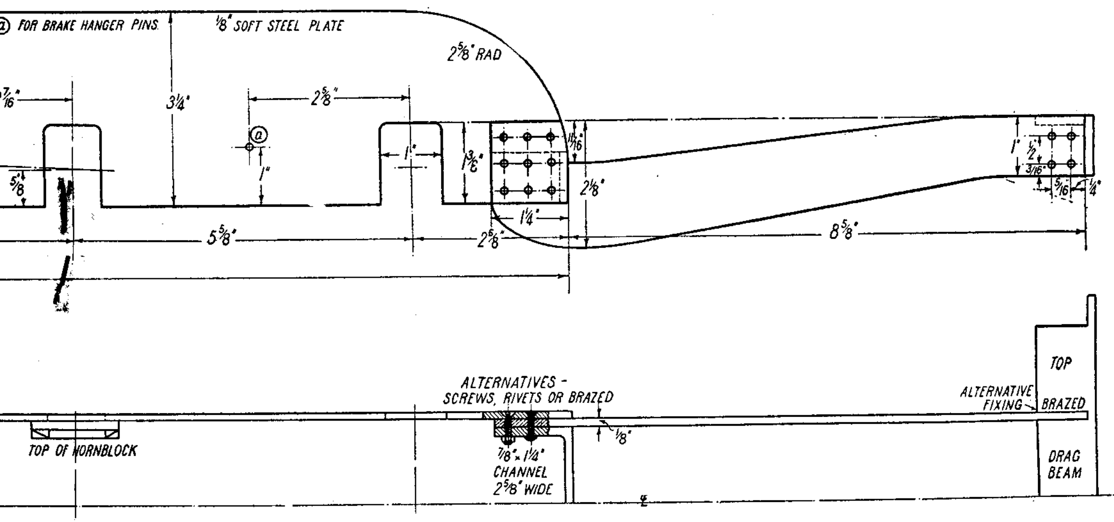
uild of a Southern Pacific

ants themselves had the thankless task of handling the engines in question, they would soon know all the “ whys and wherefores,” and proceeded to “ shoot the whole works.” This has caused some of our own readers, who know my own personal views on the subject, to write and ask that, if a miracle happened, and your humble servant had charge of the steam locomotive department of the Southern Region, what would I do about it ?

Well, I guess that the best way to reply to that, is to give a brief description of a $3\frac{1}{2}$-in. gauge “ spam-can ” rebuilt to my own specifications ;



nadorned”—(S) Pam minus can



elow, half plan of frames erected

you can then put the matter to the test for yourselves. Whilst I hate the sound of the word "standardisation," which always reminds me of convicts' uniforms, or a block of so-called modern council flats, nobody realises more fully, that for effective maintenance, low costs, and speedy repairs and replacements, it is a great advantage to have various locomotive components interchangeable on different classes of engines. In that, I humbly follow in the footsteps of one of my "heroes," the "immortal Billy." Now, let us apply that idea to the job in hand, and see how it pans out; but first we must do a bit of wholesale scrapping, and get rid of the causes of the trouble.

The first thing to do, is to get rid of the "can," the practically useless casing that covers the engine, and see what we have to work on. As originally built, the engines looked worse *without* the casing than with it, as anyone will agree if they had seen one minus its "flannel jacket," as it was called in the sheds. Next, we take off the whole of the doings that wastes steam, mops up gallons of oil, and causes trouble in galore; the three cylinders, and the chain-driven boxed-in valve gear. Removal of these, and all the appurtenances that go with them, leave us with a frame complete with bogie, six-coupled wheels, and a pony truck. On top of this we have a good-sized boiler, with an outsize in thimbles tacked on the front in lieu of a smokebox. Obviously the latter isn't much good, so it might follow the rest to the scrapheap. Likewise, the cab, which was more or less a part of the casing. Not much left now—but what *is* left, can form the nucleus of a good-looking and efficient engine.

Finding Some Standard Parts to Suit

Next thing to do is to go over the chassis with a stick of inches, and see if there is anything in the stores which can be worked in. Aha—what's this? Bless my heart and soul! There is only a wee bit of difference between the length between bogie centre and driving axle centre on the ex-spam-can, and between the same places on a L.M.S. Class "5." Not only that, but the wheels are only a little larger. Good enough! We'll adapt *Doris's* cylinders and motion to the job. Did I hear somebody say that the stroke of the *ex*-spam-can is only 24 in., whilst *Doris* has 28-in. stroke? Well, what difference does that make? We can get over it by using a thicker piston, to bring the clearances correct; and make up for loss of leverage by increasing the bore. We should have increased the bore, anyway, with a boiler that size, so we will make it 21 in., or rather, the equivalent, as the cylinder castings will bore out to that size. The slight difference between the centres of bogie and driving axle, will make no difference at all to the valve-gear, as all that is necessary will be to lengthen the piston-rods and valve spindles a shade, and set the guide-bar brackets back a similar amount, so that they will clear the flanges of the leading coupled wheels. The shorter stroke will also make no difference to the valve-gear, as the return crankpin is easily enabled to sweep the same sized circle, by making the crank to suit.

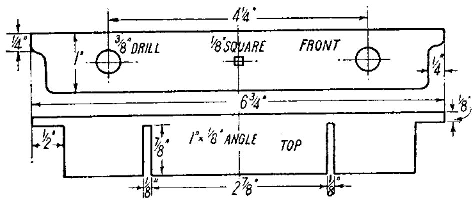
That disposes of the working parts, and the boiler can be left as it is. A new smokebox of the same diameter as the front end of the boiler, carried on a saddle of ordinary pattern, may replace the glorified thimble; a short stove-pipe chimney of adequate diameter can finish it off. A high running-board placed above the wheels, simplifies the job by eliminating splashers; this can go straight to the new cab, which is a straight sided simple affair with side windows. In full size, the spam-can tender could be retained; on a little one, it would be better to use the type of tender specified for *Doris*, which renders the backhead fittings much more accessible, and is also "standard." That completes our "imaginary rebuild"; all that remains is to give her a name. "Spam minus the can"; well, knock off the "S" and call her *Pam*, or to put it fully, and in prettier form, *Pamela*. In $3\frac{1}{2}$-in. gauge, the "rebuild" won't be a rebuild at all, says Pat, as we will have to start from zero, and I will run through the construction; but, as much of the engine will be exactly the same as *Doris*, and the same instructions apply, the description will be very much condensed, and fast workers should be able to have the engine on the road by summer. Full-size blueprints will be available from our offices, and as *Doris* castings and material are already stocked by the advertisers who supply the needful for my engines, there should be no waiting. Therefore, let's to business.

Frames

The engine frame is in two sections; the main frames carrying the bogie bolster and the coupled wheels, and an extension carrying the firebox end of the boiler. This differs from the Bulleid job, only having two members, and a simpler ashpan. It also gives the pony truck greater freedom, which is necessary, as small lines have far sharper curves than any main line; I know mine has! Two pieces of $\frac{1}{8}$-in. soft steel plate—bright or blue, doesn't matter which—$24\frac{1}{2}$ in. long and $3\frac{1}{4}$ in. wide, will be needed for the main frames. Mark one out, drill a couple of the holes near the ends, temporarily rivet together, and cut them both at one fell swoop, by aid of saw and file, as described for *Doris* and other engines. The countersinks will indicate which is the outside of each frame, after they are parted, so there won't be any fear of getting them mixed up. The hornblocks, bogie bolster and pump stay are all exactly the same as described for *Doris*. The buffer and drag beams may be made from 1-in. by $\frac{1}{8}$-in. angle, or from castings; the latter save much trouble in erecting, as the lugs for attaching the frames are, naturally, cast on, and only need slotting to take the frame-plates, which are fixed by screws. The frame-plates can be attached to angle beams, by pieces of $\frac{3}{8}$-in. by $\frac{1}{8}$-in. angle, riveted to beams and screwed to frames, as shown in the plan view, and previously described fully; or the angle fixing may be dispensed with, and the frame-plates brazed into the slots in the angles, eliminating all riveting and screwing. This is my own favourite method, as used when building *Grosvenor* and *Jeanie Deans*; it makes a sound substantial job of the frame assembly, and is in accordance with modern full-sized practice, as some engines are now built with fabricated frames, having welded joints.

The two extension frames forming the firebox

cradle, are cut from the same kind of material. About the easiest and stiffest way to erect the whole bag of tricks is to rivet each side member of the cradle to its main frame temporarily, placing it on the inside, and making sure that the end carrying the drag-beam is level with the leading end carrying the buffer beam, as both are the same height from the rails, viz., $3\frac{1}{8}$ in. Then put a piece of channel steel between the frames, as shown in the plan view, and either rivet through the whole lot, using nine $\frac{1}{8}$-in. charcoal-iron rivets each side—don't use copper rivets for frame work ; they come loose—or else put a couple of rivets in each side, just enough to hold the parts together, and braze the whole lot up solid. Anybody who owns, or has the use of an oxy-acetylene blowpipe, will find this job the proverbial " piece of cake." I find it so ; with the limited time now at my disposal, so much to do, and so little time to do it, anything that will save

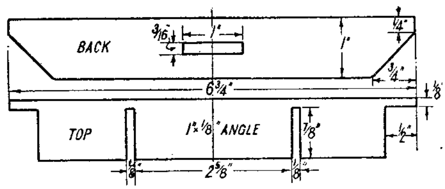


Buffer beam

time and labour is easily seized on. Whichever method you choose, don't forget to level up the frames on the lathe bed, or something equally flat and true, before fixing for keeps. Another thing to recollect is that with frames of the length being dealt with, they must be clamped firmly in position if they are to be brazed up ; otherwise they will go " all over the shop," in a manner of speaking, when one end only is heated up. I have already described, when dealing with other engines, the method I use myself, which is to put two or three distance-pieces between the frames, with a stout clamp over the outsides at each point, so that the frames are tightly held against the distance-pieces, and are unable to shift, and get out of alignment. If the whole assembly is rigidly held together, it is an easy matter to braze all the joints—buffer- and drag-beams to frames, and the joint between main frames and cradle, at one " session." Anyone who is doubtful of his abilities can make certain the last joint mentioned has no chance of shifting by putting a bolt through each side, nutting it up tightly. Naturally, you won't be able to get it out after the joints have been brazed, but that doesn't matter a Continental. Just saw or file the ends flush with the frame.

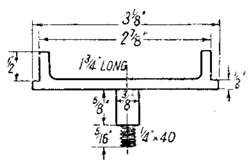
Some builders, according to what they say in correspondence, don't care for riveting frame joints and suchlike, but would rather use screws or bolts. In that case, the joint between main frames, cradle and channel stay, can be made by using countersunk screws nutted on the inside, as shown in the alternatives illustrated on the plan view.

As full instructions for machining up the bogie bolster, pump stay and hornblocks were given when describing *Doris*, and those for *Pamela* are exactly the same, I need not waste space with needless repetition, but I would remind all beginners, tyros, novices and inex-

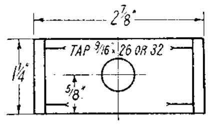


Drag beam

perienced workers " to read, mark, learn and inwardly digest " (as we used to say at school, in those happy days when a kiddy who owned a whole sixpence was reckoned among the millionaires) the full instructions for machining up and fitting the various parts for *Tich*, as given in my detailed description of that engine. The operations are precisely the same for any size and type of engine, within reason, of course. Another tip worth noting is to get the full-sized blueprints, which will be issued from our offices as already mentioned. It is much easier for a beginner to work from a full-size illustration, than to enlarge up a small illustration ; and any dimensions about which he has any doubts, or if he wants the exact size of something not " marked in plain figures," as they say at the sales, he can easily get it by measuring up the illustration on the print. Not to five places of decimals, I hasten to add, as the paper shrinks in the processing, but near enough for all practical purposes. The only dimensions I leave out are those that don't matter !



Bogie bolster



Pump stay

After finishing the frame erection, fix the bogie bolster, and the pump stay in the positions shown in the half plan of frames. The above jobs will keep all builders of this engine busy for a week or two, whilst I get out the drawings for bogie and pony truck and other parts of the running gear.

Novices' Corner

Filing Square Holes and Curved Surfaces

IT is sometimes necessary to form square holes in which a mating part must be a good working fit. As an example the blade tensioning device of a hacksaw-frame may be cited. Here, as will be seen in Fig. 1, the square tension member slides in a corresponding square hole formed in a lug attached to the saw frame.

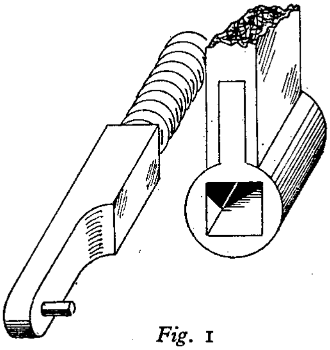


Fig. 1

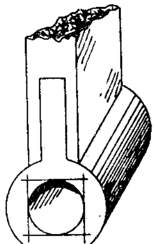


Fig. 2

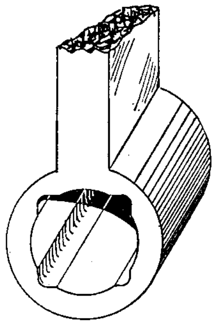


Fig. 3

The difficulty in filing such a hole lies in the tendency to bell-mouthing which is inevitable unless steps are taken to counteract it. Marking-off each end of the component though advisable to ensure the hole remaining square is really not essential and it is better to provide a more permanent witness which can serve as a guide both to the size of the hole and to its parallelism. Since the bulk of the unwanted metal must be removed by drilling, the hole so formed may well serve as a guide. Where an exceptionally neat fit is required the hole should first be drilled undersize and then brought to size by reaming. The component will then have the appearance as shown in Fig. 2.

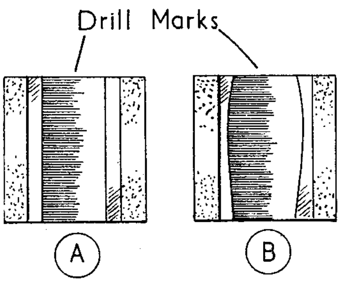


Fig. 4

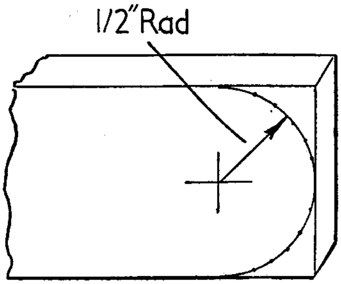


Fig. 5

The metal remaining in the corners must now be removed with a square file, working round the four sides of the square, but not entirely removing all traces of the drilled and reamed hole. For the first part of the operation a comparatively coarse square file should be used. The appearance of the hole will now be as shown in Fig. 3, and it will be noted that the corners are not sharp.

To finish the work a fine file must be used as this will have sharp corners. The four faces must be filed with care to remove all traces of the original drilling, any tendency to bell-mouthing can be checked by observing what remains of the drill marks, for if bell-mouthing is occuring it will be seen at once in the irregular outline of the drill-marks. If the hole is parallel the marks will appear as in Fig. 4A. If the hole is bell-mouthed the marking will be as in Fig. 4B.

Before completely removing all marking, the mating component should be tried in the hole. If, and when, it enters the hole the work should be held to a strong light as this will reveal any tight places which must be eased by careful filing. High spots will also reveal themselves as bright patches in the hole, but only after the mating part has been entered by tapping it lightly. Alternatively the part may be smeared with blue marking paste and pushed into the hole, high spots will then show themselves as blue patches.

Another method of ensuring an accurate fit is to use a piece of square material of the same

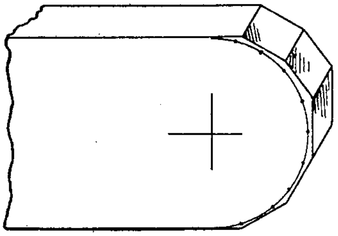


Fig. 6

size as the mating part. This is filed slightly taper so that it enters the hole and can thus be used as a gauge. It is tapped lightly with a hammer, and the high spots which are thus produced in the hole are carefully filed away until the gauge finally enters for its full length.

Filing Curved Surfaces

The filing of curved surfaces is an ever-recurrent operation in workshop practice, and examples without number will suggest themselves to readers. The surfaces involved are both external and internal and vary from very small to very large.

External Surfaces

Small surfaces can be formed directly by filing, but large areas, which involve the removal of comparatively substantial amounts of metal, must first be sawn roughly to shape. Except in the case of very small surfaces the work must first be marked-out to provide a guide line for the filing. We will assume that it is desired to form a radial end on a piece of 1-in. × ¼ in. flat material. After painting with marking fluid, which may either be thin french polish into which a little whitening has been mixed or one of the blue spirit lacquers sold for the purpose, the end of the material is marked-out with dividers as shown in Fig. 5.

Next, the bulk of the unwanted material is removed by sawing, making as many cuts as are necessary to leave the least possible amount of metal for cleaning up by filing. The work will then have the appearance shown in Fig. 6.

Care must be taken to avoid cutting into the scribed line or the part will be spoilt. The work is then filed to the marking-off line. Filing is carried out across the thickness of the material with the work held upright in the vice, and as the strokes are made the file is gradually worked round the profile. As to whether the scribed line should be toward or away from the operator is purely a matter of lighting, for it is essential that the line should be clearly visible. The surface is finally finished by draw-filing, an operation which has already been described in these articles.

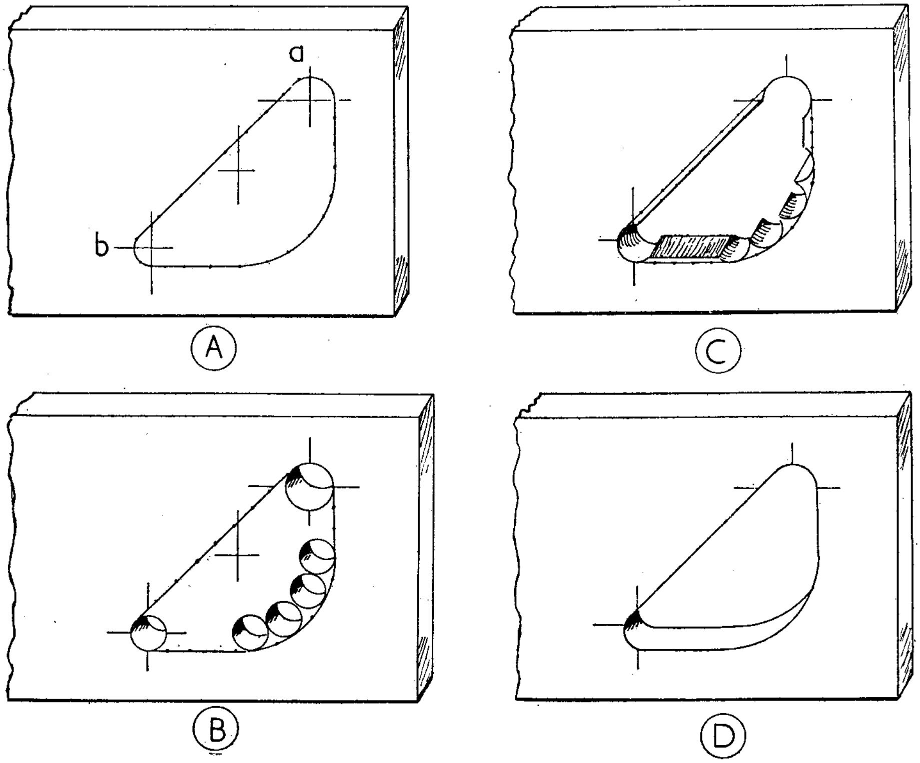


Fig. 7

Internal Curved Surfaces

There is a choice of method in forming internal surfaces. Small curves may be produced by drilling, whilst the larger can be formed

either by filing or, if the time spent on setting up the work is deemed worth while, by a machining operation in the lathe. It will be obvious that, if the curved surface is to be produced by drilling, the work must, of necessity, be carefully marked-out to ensure that the internal outline of the component is not encroached on.

The same applies with equal force to surfaces formed by machining; here, in addition, care must be taken with the setting-up. Usually, however, the larger surfaces will be formed by filing. As an example we will consider the operations necessary in cutting the internal profile shown marked-out in Fig. 7A.

The two smaller curves at *A* and *B* can well be produced by drilling, so a start is made by marking-off and drilling the necessary holes. The large curve will need to be rough formed by drilling a series of holes which can subsequently be joined up by filing. At this stage the work will appear as in Fig. 7B.

Next, after marking-off, further holes are drilled alongside *A* and *B* to enable a small hacksaw blade to be entered for cutting along the three sides of the profile. The procedure necessary has already been described in the previous article on hacksawing. The unwanted metal is now detached having the work as shown in Fig. 7C.

The profile is then carefully filed to the marking-off lines using a flat file for the straight portions and a half-round file with radius less than that of the work radius. The small curves at *A* and *B* will require no filing but care must be taken in blending the straight portions of the work into them.

This is best carried out by draw-filing and *not* by filing across the work, which should be checked for squareness with either a small depth-gauge or a toolmaker's square. The surfaces may be brought to a high finish with a cylindrical abrasive stone used as in draw-filing, or, if this is not available, a piece of fine emery cloth wrapped round a rat-tailed file will answer the purpose.

An Improved Die Holder

EVERY serious model engineer soon encounters difficulty when cutting threads squarely by hand with the small split circular dies.

Really, all that is needed is a simple guide to suit the particular diameter of rod being used.

Most of the materials can be found in the scrap box, while the time spent on the job will be richly rewarded.

As the standard die-holder is too shallow to be suitable, I have made a new one which allows extra guides to be substituted, if desired, in the future. (Fig. 1.)

For the holder, take a piece of steel shafting $1\frac{3}{8}$ in. dia. of sufficient length to finish $\frac{1}{2}$ in. face, centre and drill $\frac{9}{16}$ in. bore out to $\frac{5}{8}$ in. The recess for the die is bored out to 0.8145 in. and to a depth of $\frac{5}{16}$ in. Before removing from the chuck, the position of handles, die adjusting-screws, and cover-plate set-screws can be marked.

The handles are a simple turning operation and it is optional whether the ends are knurled or left plain.

As shown in Fig. 2, the cover-plate is a standard $\frac{5}{8}$-in. B.M.S. washer which is fixed by two 4 B.A. screws. I have found this necessary because dies have a tendency to rise when being adjusted.

The guides are steel insets (Fig. 3) turned to fit freely in the above holder. Afterwards, holes are filed out to give clearance for swarf, and the job is complete. —A. J. BETTRIDGE.

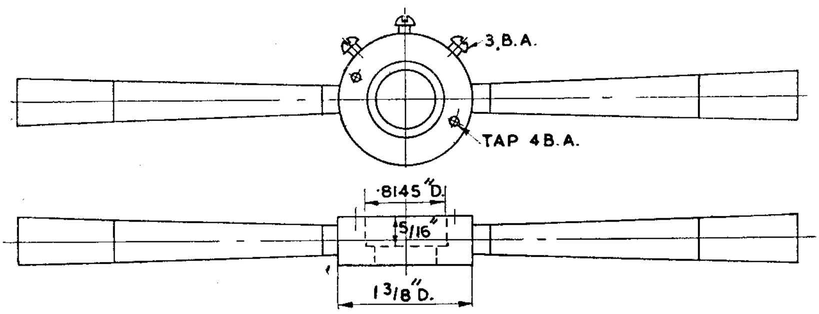


Fig. 1

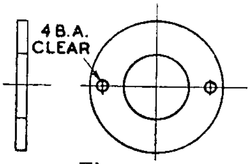


Fig. 2

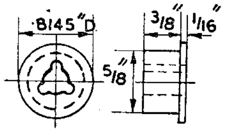


Fig. 3

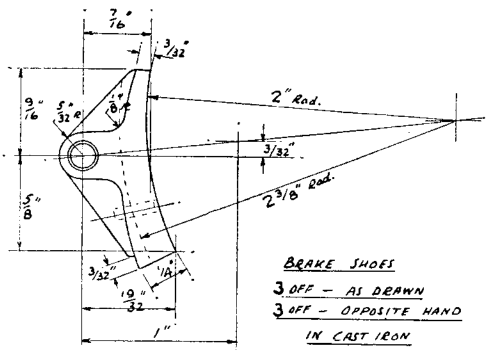
*TWIN SISTERS

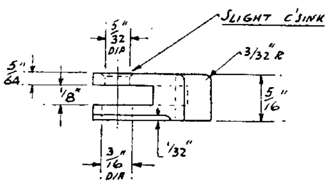
by J. I. Austen-Walton

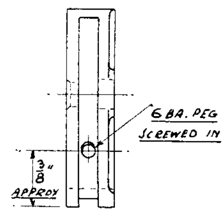
Two 5-in. gauge locomotives, exactly alike externally but very different internally

I HAVE just received a very kind letter from one of the "Major" builders who, in no unkind way, lets me know from time to time when he discovers some mistake in the drawings or diagrams, and, in every case he has been right.

I am more than grateful for this service, as I have told him, and it is unfortunate that, owing to the time that elapses before any specific article gets into print, some builders may have missed seeing the mistake before it is too late. As it happens, the little mistakes in dimensions have, so far, been of a less serious nature, which is just good luck for me.







As a rule, the parts described have been made and assembled before the drawings go to press and this is the best check of all, but lately, due to the need for more material in advance, I have had to issue descriptive matter before the work has been done.

Amongst the more recent errors, Mr. G. H. Thomas reports the following :—

He refers to the brake hanger brackets, bent up from $\frac{1}{16}$ in. sheet steel. The drawing gives a dimensioned blank for this part, and the plan view shows slight radii in the corners of the finished part although these are not specified as anything in particular. He claims that an allowance of 0.08 in. for the two bends should be made where the bend radius is 1/32 in. inside. This is quite correct, but I must admit that I planned to do something rather naughty in this small space. If you examine the construction of the brake hanger itself you will see that the outside face of the hanger will have to fit rather snugly inside the bracket, and there is hardly any room for the inside radius. There is not very much stress on this part as it happens—about 12 lb. in the horizontal plane with 100 lb. in the brake cylinder, and even then, not all this stress is in bending, as some of it is taken in single shear at the pin root.

Mr. Thomas goes on to describe his own method of bending up small parts, to ensure uniformity and strict adherence to dimensions ; he says : "To make sure that all the holes came out right, I drilled only the $\frac{3}{16}$-in. holes in the blanks and then located by this hole on a peg in a bending block $\frac{1}{2}$ in. thick ; thus, all the bends came out in relation to this hole. The outer (7/32 in.) hole was drilled in the lathe by locating and clipping the brackets on to a block held in the chuck."

This has been my own method for quite a long time, but I feel it is worth mentioning, because it has so many applications, and some of these you are bound to come across as the series progresses.

The next problem is with the leaves of the leading and driving springs. Once again, the buckle is bent up from $\frac{1}{16}$-in. sheet steel, and is shown to have a $\frac{5}{16}$-in. inside depth which is correct in certain circumstances, but the question of gauges has been the misleading factor.

I can now give you three different sets of figures that should fill the bill completely ; they are as follows :—

15 blades at 28 g. (or 0.0148 in.) = 7/32 in. (0.222) approx.
15 blades at 22 g. (or 0.028 in.) = 0.42 in.
12 blades at 20 g. (or 0.036 in.) = 0.43 in.

In other words, the buckle as shown would accommodate the 28-gauge leaves in the numbers shown. Springs made up in 22 gauge would require a buckle 0.416 in. longer *in the blank*, and 20-gauge leaves would require the same. I had, in fact, forgotten a last-minute substitution of 28 gauge in place of the 22-gauge material, when the springs were made.

The last mistake appears to be typographical only, and refers to the brake hanger hinge-pin. The drawing reproduced shows a length of $1\frac{1}{16}$ in., whereas the tracing from the same drawing shows 15/16 in., which is correct.

It so happens that, in this issue, we continue with brake gear, and for a very good reason.

**Continued from page* 153, "*M.E.*," *February* 2, 1950.

I want to get *all* the bits and pieces that hang on the chassis—inside and round the wheels, completed before such things as coupling-rods and cylinders are made, otherwise it entails extra dismantling at a stage when it is not nearly so convenient. In any case, all these parts must be made some day, and if you complete the engine without them, you will feel less inclined to pull the whole job to pieces in order to make the additions.

Although it was suggested early on that "Minor" might be allowed without brakes at all, I have counted on some simplifications that might yet tempt builders to reconsider their inclusion, and I will mention these points as we go on.

The first item is the brake hanger itself, and this is made from 3/32-in. sheet steel. There is a 1/32-in. thick steel "patch" silver-soldered on in the middle region of the hanger, to simulate the actual shape of the forging on the prototype; and believe me, it is quite noticeable. I suggest that "Minor" builders might prefer to make up a simple flat hanger to the same outline which would still be quite neat and efficient.

As forgings and castings are rather out of the question for this job, we have to fabricate the upper boss by inserting a shouldered bush and silver-soldering it in. When the bush is drilled, avoid making it a close fit on the hinge pin, as it is desirable to let the hanger swing loosely so that it can accommodate itself to the float of the wheels. As a general warning, do not forget to make the hangers "handed" if the centre patch plate is included, and remember that the bush is on the opposite side to the patch. Even the plain hangers are handed by the top bush.

Brake Shoes

On the prototype, the brake shoes are cast in iron, but on our little job it would be a bit fiddling in casting form, unless some enterprising supplier likes to take the matter up.

It order to keep strictly to type, the outside of the shoe face should be profiled round to leave the form shown on the drawing—not a very difficult job, and not calling for great accuracy or fine finish; in fact, a perfectly finished outline might look definitely wrong and overdone. I suggest that here again, builders of "Minor" might be allowed to forget the face relief, and turn out the otherwise dead simple shoe.

The best way of making brake shoes is to turn up a complete ring in cast-iron, machined all over and having a square groove turned in the outside edge to the required depth. It is then just a matter of marking out the shoe profiles on the edge of the ring, and chopping them off in the required numbers; it also ensures uniformity. In the next instalment I will illustrate this method together with the finished ring dimensions.

The pin that goes through the eye of the shoe must be practically flush with the shoe face, due to general shortage of clearances. The pin shown has two diameters, $\frac{3}{16}$ in. and 5/32 in., the latter being allowed to project very slightly to permit of light riveting-over, whilst the shoulder prevents the slot in the shoe being pinched in the operation, which, in cast-iron, is asking for trouble.

By way of a finish, I like to oil-black brake shoes by heating to a dull red and plunging them in oil. Eventually they may rust, but somehow, as much as I dislike rust, it gives a very realistic appearance to the engine.

Inside the groove of the shoe you will see a pin fitted; this is to prevent the shoe tipping forward and trailing on the wheel when the brakes are in the "off" position. You may drill and tap the hole for this, right through to the shoe face, and use a long grub-screw with a slot-head, inserted from the face side of the block; this will enable you to make a screw adjustment, but it fails to be reliable if the screw is slack in the tapped hole, as it is liable to move with vibration. I would prefer to have a fixed peg, screwed in from the slot side, and filed down until the required adjustment is found. Once the setting is right, it is not likely to wear or alter. Neither form of adjustment is visible when the shoe is assembled on the hanger.

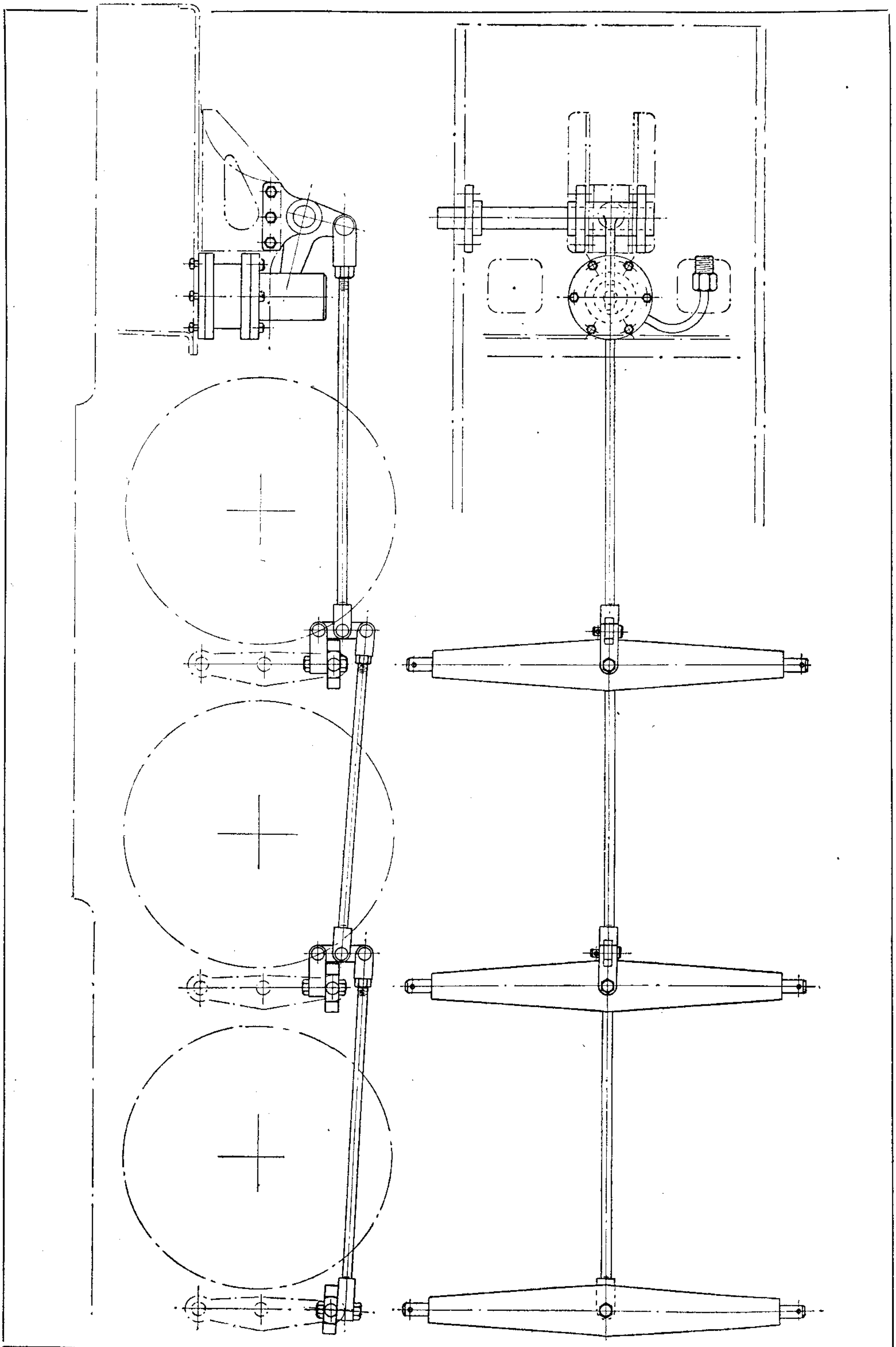
The brake stretcher bars may be made from ordinary flat mild-steel bar if you feel it to be an extravagance in stainless-steel. They will eventually be painted, and are well out of the way. Alternatively, you could make up the bars in mild-steel, and insert stainless-steel pegs, turned down to $\frac{1}{8}$ in. dia., where they enter the bar ends, and either pin them through with tiny flush rivets, or silver-solder them in place.

Whether fabricated or not, the split-pin holes in the pegs should be drilled from the flat side of the bar, just as the drawing shows. Although not mentioned on the drawing, the fitting of the tail of the hanger over the stretcher peg will be much improved if a thin washer is put immediately behind the split pin. This should be $\frac{5}{16}$ in. dia. by about 1/32 in. thick—turned and neatly chamfered. *Please* don't use an old wireless brass washer or a stamped out "ironmonger's" type.

In the centre of each stretcher there is a 5-B.A. tapped hole and you will find a shouldered bolt described to fit it, and a lock-nut to go on the other side. The length of the plain portion is given as $\frac{1}{4}$ in. FULL. The fork that is held by this bolt is $\frac{1}{4}$ in. thick, and the interpretation of "full" means that the bolt, when tightened down hard on the stretcher, right up to the shoulder behind the thread, should not pinch the fitting or restrict its free movement.

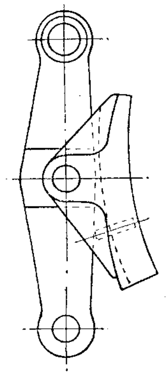
Equalisers

Although the prototype has no system of compensation for the brakes, I have considered it a very necessary refinement to add. It is one thing to get underneath a full size engine, in order to match up the brakes, and quite another thing to do the same operation on the miniature version. Not only that, matters of freedom in the springing system have something to add to the worries of the man with the small engine. On most express types of engines fitted with large wheels, it will be noticed that the point of application of the brake shoe is well below the centre of the wheel,: which tends to make adjustment even more difficult. On our job the shoe bears on the wheel at a point much nearer the wheel centre, but it would still be difficult to keep the brakes adjusted

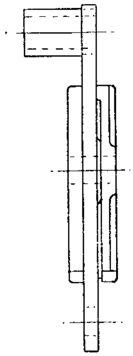


for full contact on all six wheels without some system of compensation. I have therefore devised a linkage that can be accommodated in the vertical instead of horizontal plane and, by so doing, avoided one of the greatest disadvantages of the horizontal type.

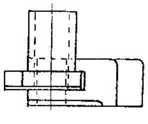
In this latter type, there is always a tendency for the pull on the stretcher bars to be biased to one side or the other, due to the need for space for the forward bars or rods to pass the forks and linkage of the previous stretcher, but with the vertical arrangement these conditions do not prevail, and the "offset" of the pull is taken axially on the brake hangers themselves, in which plane they are more than able to cope.



BRA.E HANGER ARM & SHOE. SEEN FROM LEFT HAND SIDE



VIEW OF ASSEMBLY SEEN FROM FRONT LEFT HAND SIDE



The brake rods are screwed with a little spare thread in the case of the leading and driving pair of wheels, as adjustment should only be necessary in the initial or setting up stage. The main rod to the brake cylinder crank effects the main adjustment, and is threaded accordingly and, if wear should occur at some time, all six shoes may be adjusted from the tightening of this one rod.

The rod shown is the simplest form and has a right-hand thread at each end. Adjustment is made by dropping the fork from its mating member, and screwing or unscrewing it until the required length is found. Once the fork has been replaced, there is nothing to shake loose or unscrew, and the lock-nut provided is merely to prevent the screwed end of the rod working about loosely in the captive fork; it also prevents an adjustment being lost if the rod is removed temporarily for access or cleaning, Another type of brake-rod has a right-hand thread one end and a left-hand thread the other, and with the forks tapped to suit and lock-nuts at both ends. This type enables any adjustment being made without having to remove a fork from its place; should any builders prefer to substitute this for the type shown, it would be quite in order; but, to make operation simpler, it would be advisable to drill out some short lengths of hexagon rod—the same size as the lock-nuts, to slide over the rods and to silver-solder one of these to the centre of each rod, thereby giving a spanner hold for turning the rod.

The Brake Cylinder

The brake cylinder may be made up from a casting or from bar, and phosphor-bronze or gunmetal should be used in preference to brass. This also applies to the lower trunk guide that bolts underneath. The cylinder cap or cover could be made in brass, and the spigot should not be forgotten. The important thing is to see that the six holes in the top of the cylinder are in line with the other six holes, and that the side slot in the trunk member is exactly between two sets of holes in the flange; if this is not done, and the holes are drilled in the diaphragm as shown, the side slot will not truly be facing the brake shaft that carries the crank, and this has to work in the slot without rubbing on the sides.

It is interesting to note that the upward thrust of the cylinder is taken on the diaphragm, and between the main No. 5 and No. 6 stretchers which, incidentally, act as stiffeners. As this upward load is only about 40 lb. when there is 100 lb. pressure in the cylinder, and the diaphragm is good for over 90 lb. without deflection, it serves to show how easy it is to over-estimate the strength of materials required to do a certain job, and how general clumsiness creeps in.

The joint between the cylinder cover and the cylinder should, of course, be made steamtight, and you can use whatever method you prefer to achieve this. The trunk member need only make a metal-to-metal contact as there is no pressure to hold.

There is a $\frac{1}{8}$-in. pipe to silver-solder into the cylinder and the hole for this should slope up to break through at the top of the cylinder bore, and it should be "nicked" out to miss the shallow spigot of the cylinder cover. The exact length and bend of this pipe does not matter much, but it might as well be bent as shown for the time being.

Brake Shaft and Bearings

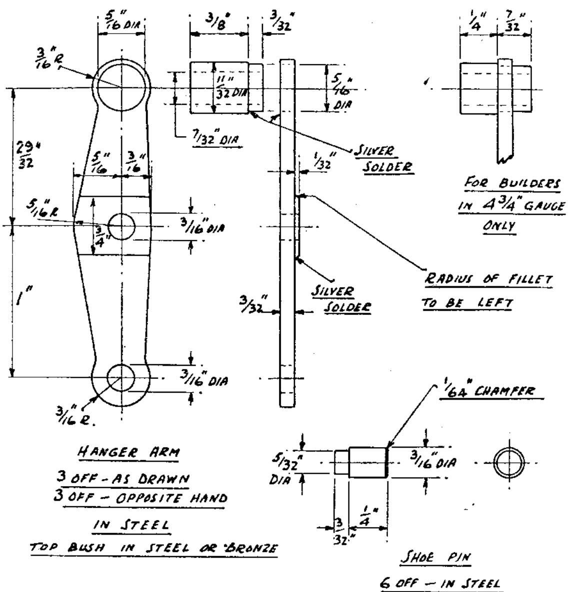
The brake shaft is just a plain shaft, in stainless-steel for preference, and lightly centred at both ends. These centres serve an ornamental purpose only, but as it entails so little bother to include them, I am sure you will put them in.

The brake shaft bearings are shown as fabricated parts, but castings would do quite well if you felt it worth the bother of making a pattern. There are three bearing points, two attached to the central brake shaft bracket assembly, and one on the right-hand side of the engine (looking forward from the cab end).

Three-in-a-line bearings always need a little more care in fitting, so here is a useful tip for the occasion: Remove the entire diaphragm assembly by undoing the service bolts, and mark off and drill for a bearing on one side only—it doesn't matter which side. This gives you the opportunity of checking up on the positions of the existing flush rivets in the bracket assembly base, and

drilling the bearing plate so as to miss these positions. If you have adhered to the dimensions given you will find that the centres of the holes miss one another.

Drill and tap 6-B.A. (two thicknesses of metal each side, so it is quite secure) and fix up one bearing with short set-bolts. Then replace the diaphragm and slide the shaft through the bearing with the other inside bearing threaded on the



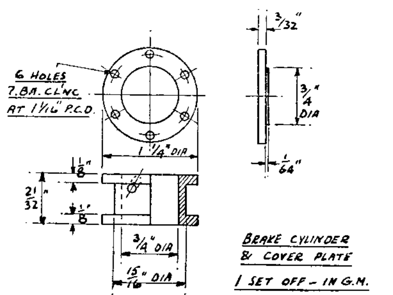
shaft. Now take the outside bearing and thread this on the shaft as well, letting it rest on the *outside* of the engine frames. Fix with a toolmaker's clamp. Now line the shaft up with a square, checking for level both ways, and making adjustments with the clamp until you achieve this. Having got a satisfactory line up, use the bearing as a jig to drill through the frames, but 6-B.A. clearing size this time. Now remove the clamp, place the bearing *inside* the frames and bolt up with 6-B.A. bolts and nuts.

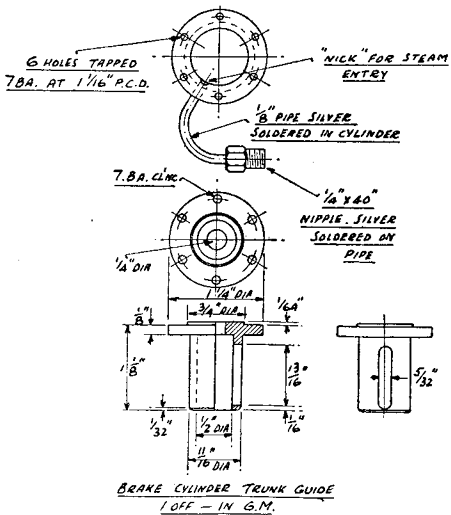
The inside and unattached bearing will now be left loose on the shaft. Hold this in place, clamping it if possible, and scribe through its fixing holes on to the bracket assembly. Do this scribing *carefully*, and see that you " pop " the centre of the scribings *truly* ; that is the whole gist of the thing, just that final operation. If these last three holes are drilled and tapped, the three bearings should be reasonably in line.

Just in case everything does not go according to plan and you have a number of tapped holes, *not* in the correct places, there is no need for gloom. Remove the whole lot and open the tapped holes to clearing size. Now make up three long bolts to go through the entire bracket assembly, and in the still watches of the night, work with a small rat-tail file until the offending bracket comes into line (there can only be *one* out of line). The working thrust is mainly downwards and forwards, and the offending bracket will settle down for life.

The brake shaft crank is a simple job, but one that I would prefer to see made in stainless-steel, as there is bound to be condensate dripping down from the brake cylinder at times, and the long arm of the crank will be tucked away inside the trunk member, and rather out of reach. Brass is *not* strong enough for this job, otherwise I would recommend its use. If you make this up in stainless-steel, aim at getting a really good polished finish round the disc part of the crank arm, as this has a slight sliding action when in use.

So this now brings us to the part where the brake shaft is left with a small piece projecting out beyond the frames, and this will later take an outside crank that mates up with the hand-





brake mechanism ; but I felt that it would be wise to leave this until we have some structure on which to fix the hand-brake.

In the next instalment I will give you all details of fork dimensions, rod lengths and linkage, together with the internals of the brake cylinder.

(*To be continued*)

Queries and Replies

Enquiries from readers, either on technical matters connected with model engineering, or referring to supplies or trade services, are dealt with in this department. Each letter must be accompanied by stamped, addressed envelope, and addressed : "Queries Dept." THE MODEL ENGINEER, 23, Great Queen Street, London, W.C.2.

Queries of a practical character, within the scope of this journal, and capable of being dealt with in a brief reply, will be answered free of charge.

More involved technical queries, requiring special investigation or research, will be dealt with according to their general interest to readers, possibly by a short explanatory article in an early issue. In some cases, the letters may be published, inviting the assistance of other readers.

Where the technical information required involves the services of an outside specialist or consultant, a fee may be charged depending upon the time and trouble involved. The amount estimated will be quoted before dealing with the query.

Only one general subject can be dealt with in a single query ; but subdivision of its details into not more than five separate questions is permissible. In no case can purely hypothetical queries, such as examination questions, be considered as within the scope of this service.

No. 9764.—Hot Air Engines
C.W.B. (Rugby)

Q.—I would like, if possible, some further information on hot air engines. In fact, I am ignorant as to their working principle.

R.—The type of hot air engine described in THE MODEL ENGINEER during April last, works on the expansion and contraction of air in a closed cycle. The main air vessel is kept as cool as possible at one end and heated at the other end, so as to produce as great a difference of temperature as possible between the two ends.

Inside this vessel is a displacer or a plunger which does not fit the bore but leaves a narrow space all round for the passage of air. By moving this plunger from one end of the chamber to the other, air is alternatively displaced to either the hot or the cold end in turn, and is, therefore, caused to expand or contract with resultant difference in pressure.

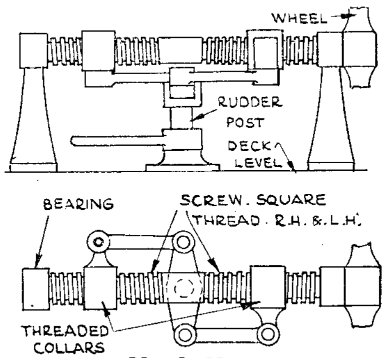
As the chamber is in communication with the main cylinder, which has the usual close-fitting piston, the expansion and contraction of air is utilised to produce the power required to turn the crank.

It may be mentioned that engines of this type have only a very small power for their size, owing to the extremely small differences of pressure obtained in this way, but they are very reliable and can be utilised for many light power purposes.

No. 9767.—Schooner Steering Gear.
R.N.B. (Dorchester)

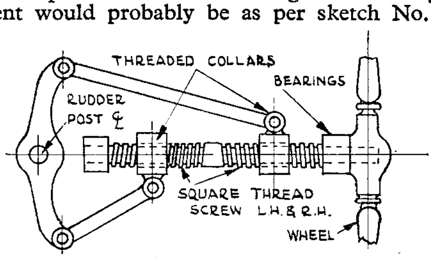
Q.—I have been asked by a friend to make the missing parts of the steering gear for a model Banks schooner. This is a very fine planked model and I want to do it justice. The gear works by means of a screwed shaft, possibly having left- and right-hand threads. This shaft is directly rotated by the wheel and, of course, is horizontal, and leads aft of the wheel and is immediately in front of and in line with the rudder-post and ship's centre-line. Operated by the screw or screws are levers attached to the rudder-post head. I shall be very much obliged if you can give me a rough sketch of the lever arrangement.

R.—If the gear is arranged so that the screw is directly over the rudder-post as was usually



Sketch No. 1

the case in square-rigged ships, the arrangement will be as per sketch No. 1. If, however, the rudder post is aft of the screw gear the arrangement would probably be as per sketch No. 2.



Sketch No. 2

In this case a slight difference in the pitch of the right- and left-hand threads or, for a model, a little slackness in the pin holes, would be necessary, to allow for peculiarities n the geometry of the arrangement.

No. 9754.—Lathe Speeds

E.H.L. (Bristol)

Q.—Recently I purchased a plain metal-turning lathe on stand with treadle, but being minus my left leg, I find I cannot use the treadle. I'm hoping to fix up the lathe with motor and countershaft, but can you advise me as to the proper size pulleys so as to give proper speeds. The motor is r.p.m. 1,420, pulley sizes on mandrel, 2½ in., 3½ in. and 4½ in. Could something be done to give extra speeds for lathes as has been done in the case of drills?

R.—Lathes are run at various speeds, according to the size of the lathe and the nature of work which is being handled, but in most small metal-working lathes, a countershaft speed of approximately 300 r.p.m. is suitable for general work. This assumes that the stepped pulley on the mandrel is a duplicate of the pulley on the lathe mandrel, and this would give mandrel speeds ranging from about 200 to 500 r.p.m. If the majority of work is fairly small, such as bar work, and comparatively soft metals are used, the mean speed may be raised to 450 or 500 r.p.m. In the first case, a 2-in. pulley on the motor and 9 in. on the countershaft will be correct, but for the higher speed, the countershaft pulley may be reduced to 7½ in. or 8 in.

No. 9761.—Thermo-couples

H.T.B. (Ballygally, Co. Antrim)

Q.—Could you give me any information about "thermo-piles" or "couples"? I am at a loss to arrange some visual level indicator and have a hazy idea that Doble fitted a "thermo-pile" on the water column which read *via* a micro voltmeter on the dashboard. Do you know how such gadgets work?

R.—With regard to the use of thermo-couples for temperature measurement, the theory underlying this device is that when dissimilar elements are joined together by welding or brazing and the joint is heated, a difference of potential is set up similar to that produced chemically in a battery, and the thermo-pile type of thermometer or pyrometer consists of thermo-couple connection to a galvanometer or milliameter.

Some information on the practical arrangement of these systems was given in the series of articles in THE MODEL ENGINEER entitled "Swords into Ploughshares," showing how these devices, which are available on the surplus market at present, can be adapted to temperature measurements.

PRACTICAL LETTERS

Steam Cylinder Passages

DEAR SIR,—I feel that the controversy over the design of steam passages in small steam engines raises points of considerable importance to builders of little locomotives and that a comparative test as proposed by "L.B.S.C." should undoubtedly be organised. It is, however, very desirable in all forms of experimental work to reduce the number of variables to the absolute minimum and it would be a mistake to endeavour in a single test on two engines, to compare the merits or otherwise of small and large cylinders, large and small steamways, straight versus curved slides, and various forms of superheater. The safe method is to build a single engine with interchangeable parts, twosets of cylinders etc., and test only one featureat a time.

One salient point seems to have been overlooked so far by your contributors and correspondents, and this is the vast difference in the piston speeds of the full sized and scaled down engines. If we consider a real locomotive having 20 in. × 28 in. cylinders, 6 ft. 6 in. driving wheels and normal steam passages, and compare this with a ¾ in. scale version having drilled passages some interesting facts emerge, as seen in the following table.:—

	Full Size	*¾ in. Scale*
Cylinders	20 in. × 28 in.	1¼ in × 1¾ in.
Wheels	6 ft. 6 in.	4⅞ in.
Speed	Say 70 m.p.h.	4.375 m.p.h. (scale speed)
Corresponding mean piston speed ..	2,212 ft./min.	138 ft./min.
Steam passages ..	Cored	5 No. 40 holes (typical "L.B.S.C.")
Piston area (A) ..	314 in.^{2}	1.225 in.^{2}
Cross sectional area of steam passages (a)	Say 30 in.^{2}	.0377 in.^{2}
Ratio $A : a$ ..	10.47 : 1	32.7 : 1
Theoretical mean steam velocity ..	23,160 ft./min.	4,502 ft./min.

Maybe the steam passages in the "real" engine would be bigger, but I doubt if they would give a mean steam velocity of much less than 15,000 ft./min. at 70 m.p.h.

Now a desirable steam velocity according to Professor Dalby in *Valves and Valve Gear Mechanisms* is from 4,000 to 6,000 ft./min., and is commonly obtained in large stationary engines. The locomotive engineer, however, cannot approach these figures without incurring high thermal losses from large clearance surfaces and steam wastage from large clearance volumes.

The drilled passage advocated by "L.B.S.C." gives (probably deliberately) a reasonable steam velocity together with small clearance surface and volume, and is evidently quite capable of filling and exhausting the cylinder satisfactorily, and incidentally is very simple to produce. Perhaps this is another instance of "nature refusing to be scaled."

Yours faithfully,

Leamington Spa. "DRILLER."

[We think that this subject, which, after all, is only of purely technical interest and not of paramount importance to the great majority of our readers, has had sufficient airing in these columns, and the correspondence is now closed. ED., "M.E."]

Vertical Boiler Roller

DEAR SIR,—The steam-roller illustrated in your "Smoke Rings" of November 24th, is one of the tandem-type, built by Messrs. Aveling and Porter, of Rochester. These rollers were designated, "Quick Reverse," had two high-pressure cylinders, and were fitted with power steering. The steering-roll was at the rear end.

A similar type of roller was also made by Messrs. Marshall & Co. of Gainsborough.

Yours faithfully,
Sheffield. W. J. HUGHES.

DEAR SIR,—You recently published a photo and letter from a correspondent, referring to a steam road roller with a vertical boiler. The photo had been taken in Calcutta in the early 1920s. The roller was British made. At this period, I was driving a steam road wagon, a "Sentinel," in the Lancs and Yorks district, and I also saw one of these road rollers with a vertical boiler at work. The most vital new thing about it was that it had *steam steering*; the driver with his vehicle stationary could swing his front roller from one full lock to the other in the twinkling of an eye. The present tendency in all heavy haulage wagons and in passenger buses, is towards increased size and weight, and in the near future, power-assisted steering may become a necessary feature of the design. Let us, therefore, keep in memory that this road roller, with its vertical boiler, was the first power-steering vehicle in Britain.

Yours faithfully,
Nelson, Lancs. JAMES ANDERTON.

Removable Flues

DEAR SIR,—I am sure we are all indebted to Mr. Messer and yourself for the notes concerning and pictures of the Robey Portable Engines with removable boiler interiors (THE MODEL ENGINEER of December 22nd, 1949, page 793).

Incidentally, the engine shown in the catalogue block includes two "extras"—an expansion governor and a hand pump.

Messrs. Richard Garrett and Sons, Ltd., used circular fireboxes on their big superheated semi-portables, and Messrs. Marshall, Sons and Co. Ltd., built a circular fireboxed portable very like the Robey. The late Mr. Henry Greenly made extended reference to this Marshall "Britannia" box in the course of some articles on portables which he contributed to THE MODEL ENGINEER during 1934.

Apart from the question of cleaning, the following advantages have been claimed for circular fireboxes in portables :—

(*a*) They allow greater ground clearance ;

(*b*) They allow of an engine sturdier as a vehicle, in that a hind axle only slightly "bowed" may be used ;

(*c*) They allow a longer grate for wood-burning, in fact an extension beyond the front-plate was often used on semi-portables.

I trust Mr. Messer will forgive me for pointing out that Messrs. Robey did build tractions, as well as a successful range of steam wagons.

Yours faithfully,
Liverpool. CHARLES LLOYD.

International Racing

DEAR SIR,—I read with a smile the different letters from your readers on the above subject. I must say that such a discussion is almost out of my mind, as I believe that racing boats find their biggest interest in one outstanding fact, SPEED. For all our boys in Switzerland, and for myself, too, we know well the difficulties which are awaiting the modeller who wants to make his own engine, and so, if he gets the good fortune to design a hot motor, we always have a great admiration for him, even if the owner has not had the difficulties which are the "daily bread" of the poor men who are the majority of the model power boat fans. However, speaking about international events, the only fact we ought to take in consideration is still SPEED, without asking about the origin of the engine, and, for us, the only winner of any model racing boat regatta will be the fastest boat on the pond.

I think Mr. Stone is a charming fellow, and we are now very good friends. He came to our country with two boats well prepared for this big regatta, he gained the first place against about ten very good boats, and we were pleased to see him taking back the "Hispano-Suiza" trophy, after very close fiighting. We were sorry that no other English competitors came to Switzerland to show us what you can do better on the other side of the channel.

Actually, we do not believe that the M.P.B.A. rules of racing are suitable for high speed events, such as international ones. We use in Switzerland the regulation established by the East Model Power Boat Circuit of U.S.A., as we have shown that the use of silencers is nonsense for engines as little as the 10 c.c. Similarly, the English harness attachments are too short. With harness attachments of 4 ft. 6 in., the boat is more quiet on the water, and it may run at higher speed.

We hope, that, this year, more British competitors will come to Switzerland for racing, and wishing them good luck.

Yours faithfully,
Geneva. PIERRE CHEVROT.

Help for an Invalid

DEAR SIR,—I am an invalid from paralysis, and I am dictating this letter to my male nurse. I must state that I am a life-long student of THE MODEL ENGINEER, and I was wondering if your or your readers could design and construct an electrically-driven invalid chair. What I really want is one to traverse about 4 m.p.h. on level ground, driven by a 12- or 24-volt car battery, fitted with two-speed gear, and easy to manoeuvre about a small room, amid furniture, which will call for some form of chain-driven, two-speed gear. At present I have an "Allwyn" push-chair, two large wheels at the back, two small ones in front. Probably one similar to this could be converted, with single-wheel steering at the front. If this could be achieved, it would tend to lighten my burden of this unfortunate affliction, and help me to propel myself to my workshop, at my own will.

Yours faithfully,
Thornton Heath. WALTER YOUNG, JNR.

[If any reader can help we shall be pleased to forward his letter.—ED., "M.E."]